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ABSTRACT

This proceeding presents 56 papers pertaining to the wide area of educational multimedia/hypermedia and telecommunications. The papers report on various stages of the development process, including the development and description of a concept, prototype development, prototype implementation and evaluation, and mainstream implementation. They cover a range of topics, including: (1) integrated World Wide Web (WWW) sites, e.g., courses on-line; (2) WWW delivery systems, e.g., WebCT, TeleTop; (3) WWW resources, e.g., Java Applets, assessment tools; (4) communications technologies, e.g., NetMeeting; (5) CD-ROM applications; (6) Novel environments; and (7) other, e.g., development processes, project management. (MES)

ED-MEDIA 1999

World Conference on Educational Multimedia, Hypermedia & Telecommunications

Edited by
Betty Collis
Ron Oliver

Proceedings of ED-MEDIA 99

WORLD CONFERENCE ON EDUCATIONAL MULTIMEDIA, HYPERMEDIA & TELECOMMUNICATIONS

Seattle, Washington, USA; June 19-24, 1999

AACE Association for the Advancement of Computing in Education

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Preface

Welcome to ED-MEDIA 99 in Seattle, USA. This year sees the conference back in the USA after two successful years in Calgary and Freiburg. ED-MEDIA 99 represents the 11th time this conference has run and this year's conference promises to be as successful as those which have preceded it.

The Conference is organised by the Association for the Advancement of Computing in Education (AACE) and over the years has developed a strong international following. The Conference has grown hand in hand with the emergence of new learning technologies and now represents the premier event for this field in the world. Each year sees an increasing number of delegates and participants and showcases the best efforts of the major advocates and researchers of learning technologies.

The strong international participation of the conference is demonstrated by the depth and breadth of submissions we have received this year for presentation at ED-MEDIA. We received over 600 proposals of full and short papers, workshops, tutorials and posters from nearly 50 different countries. Each proposal was generally reviewed by 3 referees from our panel of expert reviewers on the Program Committee. Those selected for presentation represent work of the highest quality. Our program of keynote and invited speakers once again reflects the international flavour of the programme, and we are confident that these people will inspire you by challenging your assumptions and extending your thinking.

In our roles as Program Chairs, we have been very interested to explore the types of presentations that people choose to make at ED-MEDIA. We are constantly looking for ways to bring new technologies into the mainstream of educational practices. Our reviews of the forms of research and content reflected overall in the ED-MEDIA programme makes interesting reading and provides some scope for reflection.

To aid us in this respect, we designed an analysis tool in the form of a matrix to enable us to classify the full papers, short papers and posters that were submitted to the Program Committee. The matrix considers on one axis the stage of the development process on which a paper reports. On this axis we see 4 main stages:

1. The development and description of a concept;
2. Prototype development;
3. Prototype implementation and evaluation
4. Mainstream implementation

The second axis of the matrix considers the domain of the technology. We chose to classify papers into the following categories:

1. Integrated WWW sites, eg. courses on-line
2. WWW Delivery systems, eg. WebCT, TeleTop
3. WWW resources, eg. Java Applets, assessment tools
4. Communications technologies, eg. NetMeeting
5. CD-ROM applications
6. Novel environments eg. VR
7. Others eg. development processes, project management

When submissions were classified using this schema, interesting patterns emerged. Our initial explorations indicated that the bulk of the research and development being undertaken is in Web-related areas and in particular in the development and evaluation of courses and programmes. Consider for example the results of using this schema to classify the papers considered for best paper awards at ED-MEDIA 99. These were the papers that achieved an average score of 4.5 or greater out of a maximum of 5 in the review process.

	concept	**prototype**	**evaluation**	**mainstream**
Integrated WWW sites	5	3	8	2
WWW delivery systems	2	1		
WWW resources	1	6	2	
Communications technologies			2	
CD-ROM applications			3	
Novel environ-ments eg. VR		1		
Other eg. project development	3		2	1

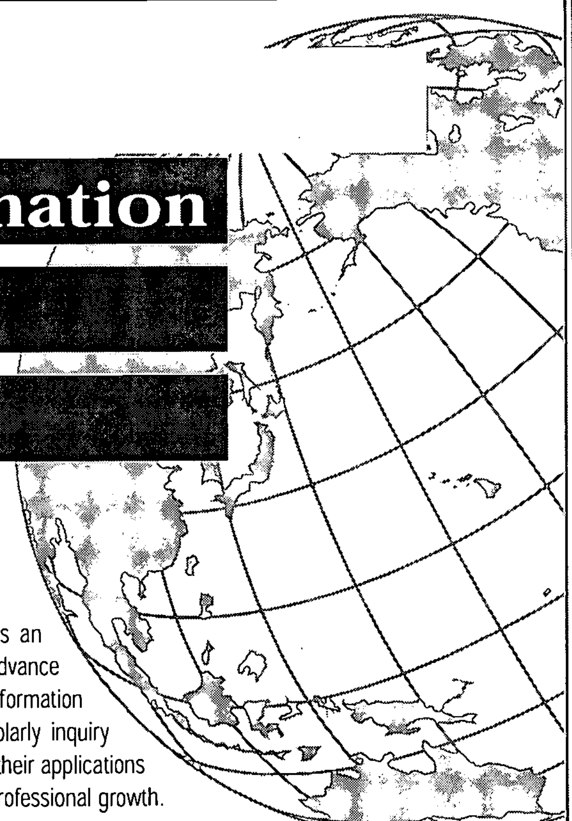
Classification of the papers considered for a Best Paper Award, ED-MEDIA 99

In terms of the stages of development, most papers tend to report prototype development and evaluation. There appear to be few ideas that go beyond this stage. Very few researchers are reporting on the mainstream use of their products and ideas. The work seems to be stopping at an early stage and not being taken to the final stage where it can really have an influence. We intend to explore these trends further and hope to be able to report back to you on our findings.

As Conference Co-Chairs we have been aided considerably by a number of volunteers and helpers who have given tirelessly of their time. In particular we must thank the Conference Steering Committee of Gary Marks, Ivan Tomek, Tom Reeves and Erik Duval who led and coordinated the conference this year. We would like to thank the Chairs of the various Program Committees, Niki Davis, Panels Chair; Sam Rebelsky, Workshops/Tutorials Chair; and Martyn Wild, Posters/Demos Chair. We would also like to thank the crew behind the scenes from AACE for their tireless efforts in coordinating and managing the huge number of administrative functions which a conference like this necessarily involves.

We look forward to meeting with you during the conference and trust that you will take the time to renew old acquaintances, meet new friends, be inspired by peers and take home some new ideas and activities to report back at ED-MEDIA 2000 in Montreal, June 26-July 1.

Betty Collis, University of Twente, The Netherlands (B.A.Collis@edte.utwente.nl)
Ron Oliver, Edith Cowan University, Western Australia (r.oliver@cowan.edu.au)



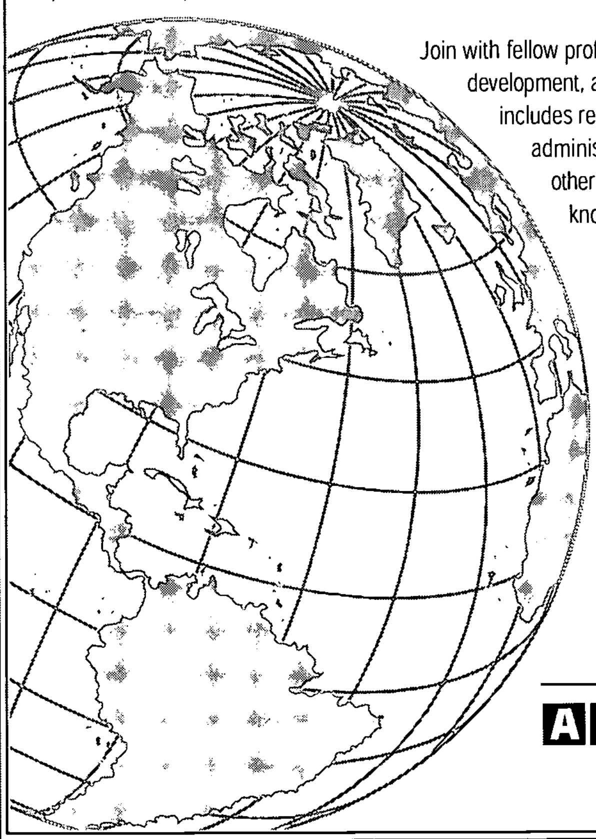
AACE

Membership Information
Conferences
Publications

Invitation to Join

The Association for the Advancement of Computing in Education (AACE) is an international, non-profit educational organization. The Association's purpose is to advance the knowledge, theory, and quality of teaching and learning at all levels with information technology. This purpose is accomplished through the encouragement of scholarly inquiry related to technology in education and the dissemination of research results and their applications through AACE sponsored publications, conferences, and other opportunities for professional growth.

AACE members have the opportunity to participate in topical and regional divisions/societies/chapters, high-quality peer-reviewed publications, and conferences.



Join with fellow professionals from around the world to share knowledge and ideas on research, development, and applications in information technology and education. AACE's membership includes researchers, developers, and practitioners in schools, colleges, and universities; administrators, policy decision-makers, professional trainers, adult educators, and other specialists in education, industry, and government with an interest in advancing knowledge and learning with information technology in education.

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Advancing Knowledge and Learning with Information Technology

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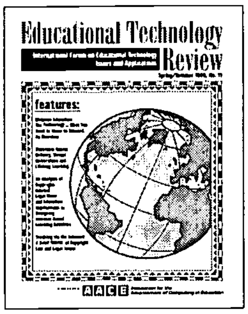
Educational Technology Review

International Forum on Educational Technology Issues & Applications
(ETR)

ISSN# 1065-6901

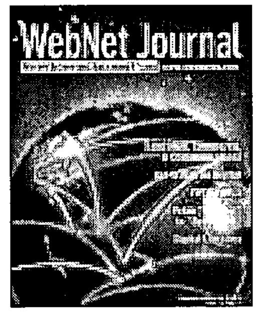


AACE's member journal is the focal point for AACE members to exchange information between disciplines, educational levels, and information technologies. It's purpose is to stimulate the growth of ideas and practical solutions which can contribute toward the improvement of education through information technology. All AACE Professional and Student Members receive *ETR* as a benefit of membership.

WebNet Journal

Internet Technologies, Applications & Issues

ISSN# 1522-192X *Quarterly*

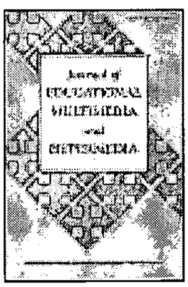


Focused on WWW, Internet, and Intranet-based technologies, applications, research, and issues, the *WebNet Journal* is intended to be an innovative collaboration between the top academic and corporate laboratory researchers, developers, and end-users. Columnists offer how-to articles and expert commentary on the latest developments.

Journal of Educational Multimedia and Hypermedia

(JEMH)

ISSN# 1055-8896 *Quarterly*

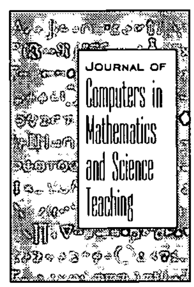


Designed to provide a multidisciplinary forum to present and discuss research, development and applications of multimedia and hypermedia in education. The main goal of the *Journal* is to contribute to the advancement of the theory and practice of learning and teaching using these powerful and promising technological tools that allow the integration of images, sound, text, and data.

Journal of Computers in Mathematics & Science Teaching

(JCMST)

ISSN# 0731-9258 *Quarterly*

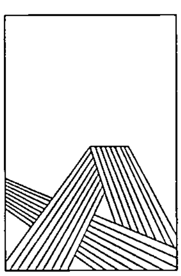


JCMST is the only periodical devoted specifically to using information technology in the teaching of mathematics and science. The *Journal* offers an in-depth forum for the interchange of information in the fields of science, mathematics, and computer science.

Journal of Interactive Learning Research

(JILR)

ISSN# 1093-023X *Quarterly*



The *Journals'* published papers relate to the underlying theory, design, implementation, effectiveness, and impact on education and training of the following interactive learning environments: authoring systems, CALL, assessment systems, CBT, computer-mediated communications, collaborative learning, distributed learning environments, performance support systems, multimedia systems, simulations and games, intelligent agents on the Internet, intelligent tutoring systems, micro- worlds, virtual reality based learning systems.

Journal of Technology and Teacher Education

(JTATE)

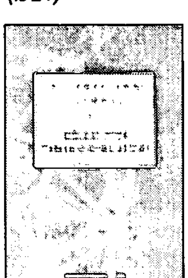
ISSN# 1059-7069 *Quarterly*

A forum for the exchange of knowledge about the use of information technology in teacher education. *Journal* content covers preservice and inservice teacher education, graduate programs in areas such as curriculum and instruction, educational administration, staff development, instructional technology, and educational computing.

International Journal of Educational Telecommunications

(IJET)

ISSN# 1077-9124 *Quarterly*

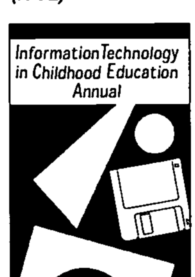


IJET serves as a forum to facilitate the international exchange of information on the current theory, research, development, and practice of telecommunications in education and training. This journal is designed for researchers, developers, and practitioners in schools, colleges, and universities; administrators, policy decision-makers, professional trainers, adult educators, and other specialists in education, industry, and government.

Information Technology in Childhood Education Annual

(ITCE)

ISSN# 1043-1055



A primary information source and forum to report the research on and applications of using information technology in the education of children—early childhood, preschool, and elementary. The annual is a valuable resource for all educators who use computers with children.

AACE Conferences

Details for conferences are available at www.aace.org/conf

The exchange of ideas and experiences is essential to the advancement of the field and the professional growth of AACE members. AACE sponsors conferences each year where members learn about research, developments, and applications in their fields; have an opportunity to participate in papers, panels, poster/demonstrations and workshops; and meet invited speakers.

ED-MEDIA 2000

World Conference on Educational Multimedia, Hypermedia & Telecommunications

JUNE 26-JULY 1, 2000 • MONTRÉAL, CANADA

ED-MEDIA - World Conference on Educational Multimedia, Hypermedia & Telecommunications

This 12th annual conference serves as a multidisciplinary forum for the discussion of the latest research, developments, and applications of multimedia, hypermedia, and telecommunications for all levels of education.

WebNet 99

World Conference on the WWW and Internet

OCT. 30-NOV. 4, 1999 • SAN ANTONIO, TX USA

OCTOBER 25-30, 2000 • HONOLULU, HAWAII USA

WebNet - World Conference on the WWW & Internet

This annual conference enables the exchange of information in these major topics: Commercial, Business, Professional, and Community Applications; Education Applications; Electronic Publishing and Digital Libraries; Ergonomic, Interface, and Cognitive Issues; General Web Tools and Facilities; Personal Applications and Environments; Societal Issues, including Legal, Standards, and International Issues; and Web Technical Facilities.

International Conference on M/SET 2000

Mathematics/Science Education & Technology

FEBRUARY 5-8, 2000 • SAN DIEGO, CA USA

M/SET - International Conference on Mathematics/Science Education & Technology

The conference focuses upon information technology in mathematics, science and computer science education across all levels and settings, including elementary, secondary, college, and teacher education. Learn about the current research, development, classroom applications, issues, theory, and trends.

Society for Information Technology & Teacher Education 2000

11th International Conference

FEBRUARY 8-12, 2000 • SAN DIEGO, CA USA

SITE - Society for Information Technology and Teacher Education International Conference

This conference, held annually, offers opportunities to share ideas and expertise on all topics related to the use of information technology in teacher education and instruction about information technology for all disciplines in preservice, inservice, and graduate teacher education.

Co-Sponsored Conferences

ICCE - International Conference on Computers in Education

ICCE is an annual event focusing on a broad spectrum of interdisciplinary research topics concerned with theories, technologies and practices of applying computers in education. It provides a forum for interchange among educators, cognitive and computer scientists, and practitioners throughout the world, especially from the Asia-Pacific region.

NOVEMBER 4-7, 1999 • CHIBA, JAPAN

ICLS - International Conference on the Learning Sciences

ICLS, held biennially, is designed for researchers, developers, practitioners, consumers, and policy makers to share experiences and insights on fostering effective learning to serve real-world needs. Represented are a diverse group from the fields of cognitive science, multimedia, training, education, and artificial intelligence.

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- ❑ *Information Technology in Childhood Education Annual (ITCE)*
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Annual membership includes a choice of AACE-sponsored journals, membership in a related Division/Society, a subscription to *Educational Technology Review* (member magazine), discounts for conferences, proceedings books & CD-Roms.

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4 journals + Ed. Tech. Review	$225	$110	$ ____
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❑ *Jrl. of Technology and Teacher Education (JTATE)*	$95
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TABLE OF CONTENTS

PREFACE

KEYNOTE PAPERS

INVITED SPEAKERS

FULL PAPERS

SHORT PAPER

SHORT PAPERS - WORKS IN PROGRESS

POSTER / DEMONSTRATION PAPERS

TABLE OF CONTENTS
Addendum

KEYNOTE SPEAKERS

Educational Reform by Information and Communications Technology: ICT Strategies for Educational Improvement-A Japanese Perspective

Takashi Sakamoto
Director-General
National Institute of Multimedia Education
Japan
sakamoto@nime.ac.jp

Abstract: In traditional education, students belong to only one school and passively learn from teachers through information transmission such as lectures and classroom demonstrations, along with a few opportunities for active participation. Traditional approaches to education are not effective enough to prepare citizens to cope with the complicated problems of the changing societies of the 21st century. Students need to develop the skills that will enable them to become lifelong learners.

Using information and communications technology, we could overcome borders of countries, universities, schools and academic subjects, and also barriers of even time and location. Each student could select the best course or even the best school or university in the world, according to his/her own interests, by means of internet, satellite and multimedia technology. Information and communications technology is reforming education. Recent examples of internet use in schools, satellite use in universities, new types of multimedia development will be described.

1. Culture Characterized by a Private Room and Culture Characterized by a Living Room

Some twenty years ago, when a British friend of mine and I were driving through an old neighborhood in London, he pointed toward the sky and said, "Look at the skyline over there. You can see small chimneys on the roof of each house. Four chimneys, six chimneys there s a roof with eight. Each one of them connects to a fireplace in a private room with a locked door. Most of these children have their own rooms. Many of them, boys and girls both, will leave their homes after high school and live independently in their own flats."

After this conversation, I began to pay closer attention to this ubiquitous element of so many Western skylines, although today, of course, more chimneys serve as a vent or decorative element than as an actual conduit for smoke.

Which brings me to the question: How are Japanese houses structured? We can begin by saying that Japanese homes have a completely different structure than their Western counterparts. A typical Japanese house features a central living room surrounded by a number of other, smaller rooms. These other rooms are partitioned by simple paper screens or papered sliding doors called fusuma. Because there are no locks or keys, anyone can open these partitions. Within the living room itself, this strategy of free-flowing division is often continued by means of free-standing panels or folding screens. In this sense, Japanese homes are extremely flexible and open. It is possible that this difference between Japanese and Western homes derived from climatic conditions. Western homes must bear the severe cold of winter, but Japanese homes must bear the heat and humidity of summer. But what I most want to emphasize here is that the respective openness and containment of the Japanese and Western architectural styles seems to have strongly influenced the way the members of these cultures think and behave.

In Europe, individuals are of primary importance. They join to form a group as equal participants. Brothers and sisters call each other by their first names. In one case, I even know of secondary school students who call their parents John and Mary. Parents, brothers, and sisters hold seemingly equal positions.

In Japan, on the other hand, younger brothers and sisters often call their elder brothers and sisters simply "brother" or "sister," rather than using their first names. Children almost never address their parents by their first names. When sitting around the fire, the head of the household sits in a central position, and the others hold their respective positions in the order of seniority, men and women. There has been a clear hierarchy among family members. In terms of privacy, even if children are given private rooms, their parents are able to open the paper screens or papered sliding doors at any time. The solidarity of the group is thus considered much more important than the exertion of one's individuality. In the center of the house is a living room with a fire. Private rooms, if they exist at all, are only temporary constructions. In Western homes, the living room is a place for communication where family members demonstrate their own individuality while respecting the individuality of the other members. Schools, which are designed as an extension of the home, are often equipped with a central open space. Just as at home, children realize their own individualities within this educational space, while remaining careful to respect the individualities of their peers. In the past, as an extension of the home-fire setting, schools in Japan were often called classroom kingdoms, with children studying together under a teacher who served as "king."

Today, however, with the exception of a number of large, country homes, a more west-European style of living prevails throughout Japan. Apartments increasingly consist of private rooms with a key. In this sense, people's life styles are steadily shifting to include an assertion of privacy.

A key signifies one's domination over what is locked. Without a key, no one can get into a domicile, or take anything out. In the past, then, a key was a security measure by which wealthy people protected their property. In an environment where people from different ethnic groups and social classes lived together, a key was a protective necessity. In earlier Japan, however, keys were largely superfluous. Villagers helped each other and treasured common property, private ownership of which was forbidden. Personal belongings were acknowledged by other group members and thus did not have to be locked up. This was the case in which group members are homogeneous.

In societies of this type, individuals obeyed the group to which they belonged. Dissenting viewpoints were unwelcome and were considered to disturb the collective harmony. This system worked quite well when the group leader was well-intentioned and capable. But in the absence of effective leadership, the results of this paradigm could be tragic. Then, group members who had very good ideas that might have improved the situation were hardly allowed to propose them, and people generally withheld their creative ideas for reform or their initiatives for problem solving.

This Japanese model of society tended to work best under peaceful conditions and with a group of reliable members from the same ethnic background. In the modern age, it has become increasingly difficult for a society to exist in such relative autonomy, and the necessity of contact with different cultural backgrounds has made a purely homogeneous group impossible.

In Western culture, individuals are not only permitted, but often encouraged to assert their own ideas. But their contemporaries must be persuaded of the logical efficacy of a particular idea before it will be implemented. Failure to persuade others can lead to the dissolution of a group. Thus a culture characterized by a "private room" mentality finds it difficult to maintain the group's common purposes and solidarity while simultaneously encouraging individuals to display their creativity and problem-solving abilities. On the other hand, a culture characterized by the "living room" paradigm is effective at engendering solidarity and sharing property, but less effective at maximizing the individual strengths of its members.

Education in the 21st Century will continue to develop along with internationalization, advances in science and information technology, and an increasing population of elderly and decreasing population of children. Cultures characterized by private rooms and those characterized by living rooms will meet more frequently everywhere. And the question of whether to adopt a "living room" culture while developing a "private room" culture, or to adopt a "private room" culture while developing a "living room" culture is now in the critical point.

Education in Europe and North America is shifting away from the "private room" model and placing new emphasis on characteristics of a "living room" culture, such as collective purpose and common standards. Conversely, education in Japan is shifting toward a new focus on respect for individuals, and in opening up the classroom "kingdom" in an attempt to communicate with different cultures while maintaining student individuality. In this way, both Europe/North America and Japan are attempting to recognize and assimilate the strengths of one another's systems.

Japanese education in the 21st Century will also attempt to further the open and flexible way of Japanese living so as to expand the "living room" culture from the home to the social unit, from the social unit to the nation, and from the nation to the world. It is important that this expansion also respects the independence of individual students by means of flexible temporary partitions made up of free-standing panels, folding screens, paper screens, and papered sliding doors, as well as by a "latch of the heart."

Learning to exploit advanced information and communications technologies is important whether the aim of education is to develop a cooperative mind with an emphasis on individuality, or an individualist mind with an emphasis on cooperation. It is important because such tools as multimedia content, home pages, databases, and network communications not only allow access to the inspired ideas of many individuals, but can also nonetheless be applied to achieving common goals.

2. Changes in Learning Styles

In the realm of 21st Century education, the learning styles of children everywhere will change.

Since antiquity, human beings have tended to acquire knowledge in a largely passive manner. That is, knowledge has been passed on from men of wisdom and authority. The Analects of Confucius and the sermons of Buddha and Christ are typical examples. People listened to the speeches of these seminal instructors in order to gain instruction for their lives. Even after the invention of the printing press, learning meant passive reading of the writings of knowledgeable and authoritative authors. In Japan, such wisdom was usually imparted in the course of repeated silent readings.

The introduction of radio and television did not change this model of passive learning. Even in school broadcasts, the University of the Air, and other types of distance education, the ordinary style of learning is to learn passively through a teacher's presentation and a textbook. Those who appear on these broadcasts are still men or women of wisdom and authority, and their students continue to be largely passive recipients.

Even this passive learning environment, however, sometimes involves more constructive activities in the form of submitting reports and taking examinations. And, with the growing emphasis being placed on searching skills and active learning, investigative and constructive activities have become important. This has resulted in a wide range applications, from scientific investigations or an observational diary, to a general emphasis particularly in elementary school on careful articulation of opinions.

This type of active learning will continue to expand along with the refinement of the various media which support it. One notable aspect of active learning concerns the selection of pertinent information. Recently, huge volumes of educational information have been made available to students, including textbooks, illustrated guides, newspapers, magazines, printed materials, web pages, and TV, radio, video, and computerized teaching materials. Learners must positively select the information appropriate for their learning. If learners take in information without a critical view, they will find themselves drowning in a sea of information. They must also compare, process, edit, and compile the selected information in order to produce a finished report or presentation. This process is an excellent example of learning through creating. Such engaged learning is critical, because learners understand content more deeply when creating something on their own.

Multimedia and the Internet are powerful instruments to support this process. Learners extract information from the web pages of universities, museums, companies, etc., or take digital-camera photos of their community, neighbors, or local parks, and then gather all this information into a computer, edit it, and complete a multimedia work. They can show the finished product to friends around the world via e-mail or a web page. But the opportunity for learning does not stop here. Friends and anonymous enthusiasts around the world are likely to respond to the student's work with questions, supplemental material, or corrections. And these responses will further motivate the child to reinvestigate, review and modify his or her works. This process for deepening the learning experience is not possible via conventional teaching methods.

What is particularly important is that new tools for expression, such as cameras, videos, word processors, and computers have appeared and spread. As a result, the communications world that once focused mainly on receiving information has now evolved into a world of transmission as well. Ordinary people can easily transmit words, voice, sound, still images, and moving video images. Today, business people routinely create and transmit information using multimedia tools and word processors. Even children can draw pictures on their computers and win competitions in contests with middle school students or older competitors. In one instance, a first grader in primary school created a multimedia work, stored it on a floppy disc, entered a contest, and won the Ministry of Education's Prize. And there is currently a primary-school boy who is creating "multimedia poems."

Originally, when people drew pictures, sang songs, played musical instruments, or recited sentences, they were transmitting messages in the same way that they communicated spoken words. Often, it was a process which required considerable time and effort. With a computer, however, one can draw pictures and compose music easily. The pictures drawn and music composed on a computer can be modified or duplicated an unlimited number of times. Mistakes can be instantly undone with the click of a mouse. In the case of real paintings or musical scores, however, because erasing is so difficult, the expression of radical new ideas is less likely. Also, with the current prevalence of word processors, an "information sending" society in which everyone can be a sender of information is rapidly approaching. Today, if a school is linked to a network, one individual can disseminate a message all over the world.

In this way, written media as a source of information has expanded to multimedia. We can selectively receive information from the media through reliable databases. We can also send multimedia information of our own. We are in the midst of a great change in the history of civilization.

In the 21st Century, the understanding, exploitation, creation, and transmission of multimedia information will become nothing special. Information integrating text, still images, moving video images, voice, and sound is expected to be routinely delivered on networks.

Learners in the coming advanced information society will have to possess not only the skills of reading, writing, and understanding information delivered from numerous media, including TV, but also the skills to retrieve and use multimedia information, and to create and transmit multimedia works.

In receiving information from the media, we must have the ability to distinguish authentic information from inauthentic or biased information, and we must be able to make this distinction independently, as individual agents. We also must be careful not to lose touch with the physical world around us through an excessive reliance on information. When sending information, we must be careful not to invade the privacy of others. We should not use or create biased or erroneous information. We must respect the intellectual property rights of information created by others. To act responsibly, learners must be aware of the importance of information for life in society.

3. Educational Reform by Information and Communications Technology

Information and communications technology are dramatically changing many aspects of education, including the essential functions, goals and contents of education, the methods, teaching materials, management, administration, and teacher education used to realize these goals, and the partnership between education and the local community.

- Essence of Education

Education has always had two major functions. The first is to hand on to successive generations the academic, cultural, technological, and traditional heritage of our ancestors. The second is to help foster desirable characteristics in the citizens of the next generation, and thus of the societies of the future. Elements to be fostered include creativity, imagination, the skills to express oneself, sensitivity, ethics, motivation, physical strength, coordination, collaboration, cooperation, and independence.

The essence of education has not changed even in the multimedia and Internet age. However, other aspects of education are likely to be affected by the requirements of particular times.

- Goals and Contents of Education

In the past, the goals of education have tended to focus on the first of the functions described above, the acquisition of knowledge as an inheritance from previous generations. Today, however, new emphasis is being placed on the second function, i.e., the evocation of student interest and motivation, and the fostering of intelligence, judgment, and self-expression. Stronger emphasis is being placed on developing the ability to take the initiative in creating a future society, than on inheriting past assets. In Japan, the goal of the new education is to foster a "zest for living."

The emergence of multimedia and the Internet has dramatically altered the goals of education. Knowledge and skills of information technology, an understanding of the role and importance of information technology in the society, and information ethics are new goals of education. And as the goals of education change, the educational contents change with them. To educate students to achieve an equal academic level nationwide requires consistent curricula throughout primary and secondary education.

- Methods of Education

The most drastic educational change resulting from the advent of multimedia and the Internet is in the educational methods themselves. Newly introduced teaching methods include individual learning that exploits multimedia instructional materials, creation of multimedia works (e.g., multimedia illustrated guides that integrate text, music and pictures), exchange of presentations with other children on the Internet, collection of necessary material from databases, global simultaneous computation of records, and classroom exchanges via satellite and telecommunication network.

- Instructional Materials

Multimedia instructional materials in the form of CD-ROM and DVD-ROM have been added to such conventional instructional materials as print media, models, slides, and OHP. Instructional materials are directly collected from various sources around the world via the Internet. Lists of links to instructional material sources are also available. In recent years, so-called tool software has been used widely. And application software itself designed to help children collect, process, edit, create, and transmit information is sometimes used as an instructional material.

- Facilities and Equipment

Equipment includes peripheral devices for computers and multimedia tools, network systems, and basic software. Facilities need to be expanded to install these devices and systems. In particular, recent years have seen the spread of communications satellites, videoconferencing systems, and high-speed communications networks.

- Management of Education

Because schools are connected to the whole world through networks, one can instantly gain access to worldwide education-related information. Distant schools and experts can carry out team teaching, and networks and communications satellites will help make conferences, meetings, and training courses more efficient.

- Administration of Education

The introduction of multimedia and the Internet is also changing the administration of education. This will mean changes in all aspects of education administration, including governmental policy making, budgeting, and dissemination activities to facilitate the exploitation of information technology for education.

- Teacher Education

Because multimedia and the Internet are new to the world of education, many teachers still have difficulty using them. Not surprisingly, multimedia and the Internet are recurrent themes at the training events, workshops, and academic meetings of teachers worldwide. Through such training, teachers will be able to acquire new abilities, including the skills to analyze and develop instructional materials and to use multimedia and the Internet.

- Partnership with the Local Community

By making multimedia equipment and the Internet available to the local community, schools can assert themselves as centers of culture and civilization in less developed regions. In developed regions, constant interactions between schools and the local community will be possible on networks.

4. Exploitation of the Internet for Education

It is interesting to speculate what might happen if cross-cultural communications continue to increase through the Internet and videoconferencing systems. With cameras and videocameras, children will be able to collect and edit the information surrounding them, e.g., information on nature, society, customs, languages, cultural heritage, and the people of their community, and use this information to create a multimedia work. They will then present their project on a home page or send it to friends in distant places via e-mail. Their friends will reciprocate with similar multimedia works. Children will ask questions about and exchange opinions on these works. Using this information, they will create better works and send them to friends in distant places. For example, children in snowy regions might tell children in the South Pacific about their own customs, practices, lives, and play in the snow-filled winter. Conversely, children in the South Pacific might share information about tropical foods and the habitats of tropical fish in a coral reef. Children in urban cities might admonish children in farming villages, "You should not use agrichemicals." Children in farming villages might counter them by saying, "We cannot produce good-looking agricultural products without agrichemicals. Will people in urban cities buy poorly shaped vegetables and fruits?" In this way children will understand that others may have different positions.

Utilizing the Internet in this way, children will be able to better understand their own cultures by cross-comparison with other cultures worldwide. They will begin to appreciate that acknowledging and respecting different cultures is integral to protecting and fostering their own. It may not be too much to hope that, as children continue to interact with different cultures on the Internet, some of the ethnic conflicts currently underway throughout the world will begin to disappear. In this way, the educational use of the Internet will truly be an effective means of engendering peace.

The so-called "100-School Networking Project" launched in FY (Fiscal Year) 1995 with the participation of 111 schools completed its tenure of two years. A new 100-School Networking Project is now in progress. Diversified activities are being carried out at schools and other educational organizations in and outside Japan. These activities include the gathering, transmission and exchange of information, collaborative learning and research, collaborative production, and network conferencing.

Furthermore, the "KONET Plan", designed to link 1,014 schools via the Internet and a videoconferencing system, has already been launched. Many activities such as interaction via e-mail, information gathering, and homepage creation are being conducted.

In addition to these projects, such areas as Gifu, Kochi, Saga and Osaka prefectures, and Mitaka City have actively been introducing the Internet. Non-profit institutions such as Media Kids have also contributed to increased internet use by students.

In FY 1997, classroom teaching, linking a classroom in a hospital and a master classroom in a school via optical communications, was started in order to teach, at a distance, children suffering from an illness.

The Ministry of Education has also selected 20 districts to study the effects of an information and communications network, designating six schools in each site. As part of the R&D project to study the use of advanced information and communications facilities for schools in rural areas, the Ministry linked schools in rural areas with schools in urban areas. These schools are connected via two sets of satellite communications systems, ten sets of optical communications, and 19 sets of digital communications networks. In many cases, children in rural areas benefit from acquiring vivid information from urban schools. It is expected that children in rural areas will, in turn, provide those in urban areas with information on their rich natural environment and traditional culture, thus contributing to each other's learning.

The FY 1998 supplementary budget included a plan to connect a total of 118 schools by optical communications. These schools comprise two schools from each of 47 prefectures and 12 cities designated by government ordinance. Approximately 1,100 schools in 30 local districts are also connected through either CATV, WLL (Wireless Local Loop), DSL (Digital Subscriber Line), or satellite internet communication technologies.

5. Effects of Information Technology on Education

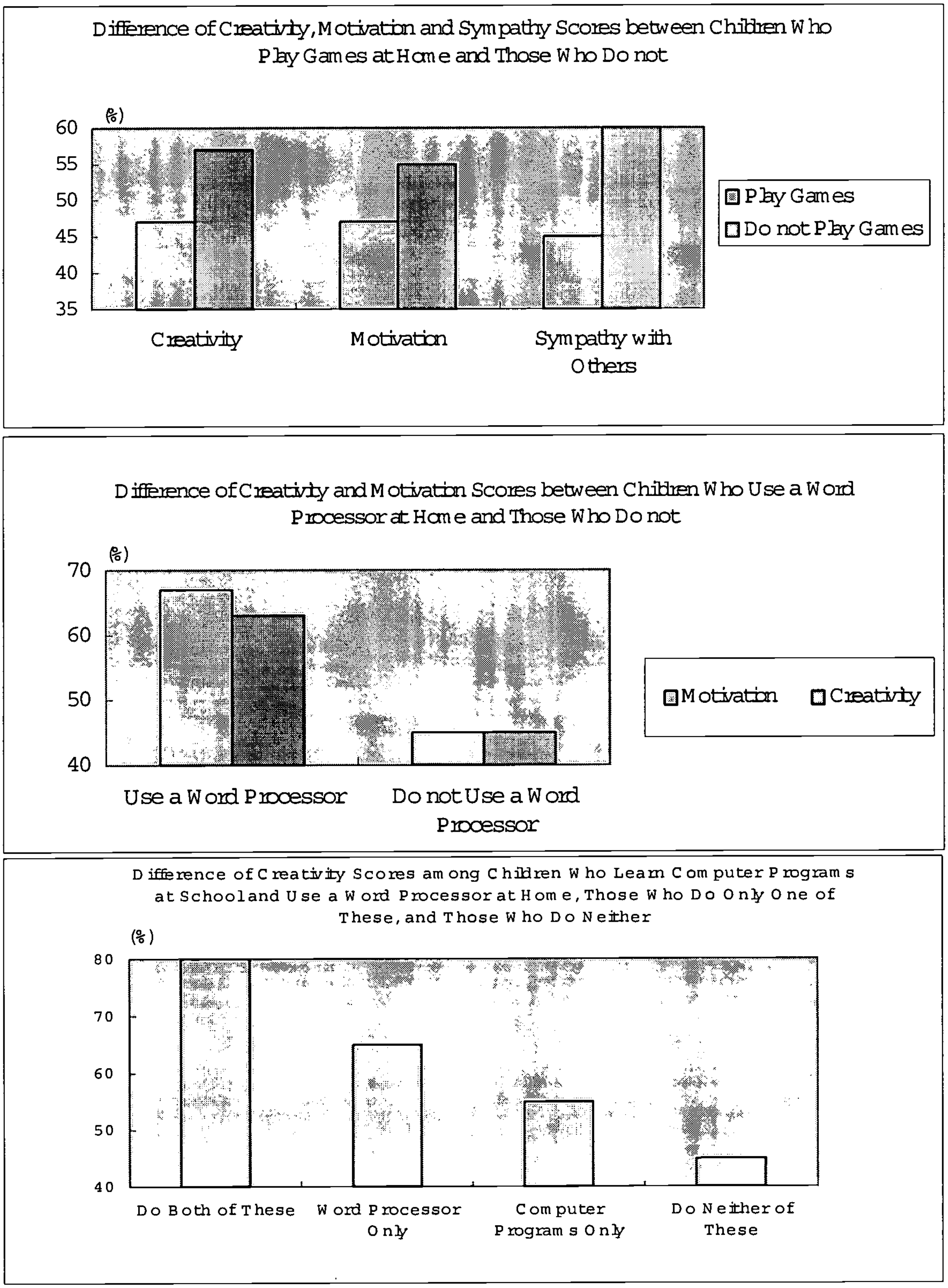
The research on the effects of computer-aided instruction (CAI) in enhancing educational experiences has been undertaken by many studies. In fact, as computers are increasingly used for problem-solving, material production, information retrieval and transmission, etc., their effectiveness is no longer in question. Computer-assisted graphs, composition, arrangement, drawings, and multimedia works are ubiquitous, and many of these projects have placed first in distinguished contests. Such prize-winning works could not have been created without computers.

Certainly, computers have made a substantial contribution to education, if for no other reason than because students cannot easily gather, retrieve, create, and transmit information without a computer or the Internet. But we must ask ourselves, do computers offer any benefits other than convenience? More specifically, do computers help develop children's ability to collect information, solve problems, edit existing material, create new things, think logically, and fully express what they think or feel? Now that the Internet and multimedia computers have been introduced to most schools, studies to answer these questions are extremely important.

For many years now, our group has been investigating the effects of computers and the Internet on education. The earlier outcome of our study showed that, as in Figure 1, fifth graders playing video games at home showed lower levels of creativity, motivation, and sympathy with others than those not playing games. In contrast, fifth graders using a word processor at home showed higher levels of creativity and motivation than those not using a word processor. The children who both learned computer programs at school and used a word processor at home showed higher levels of creativity than the children who did only one of these activities. Not surprisingly, those children who engaged in neither activity demonstrated the lowest creativity scores. In analyzing these results, it is noteworthy that the children who both played games and used a word processor at home showed high creativity scores. Our expectation was that children who participated in both these activities would demonstrate median-levels of creativity, intermediate between the low scores of those who only played video games and the high scores of those who only engaged in word processing. However, the children who did both showed the highest creativity scores. Although it is difficult to interpret this result conclusively, it seems reasonable that these children realized a synergistic effect between the constructive skills gained from word processing and the instantaneous judgment skills gained from playing video games.

In this study, creativity was assessed by means of questionnaires. We subsequently devised a test to measure thinking ability more accurately and conducted a six-month panel survey of the same subject group of fifth graders.

Figure 1. How does a computer affect the development of children's abilities?



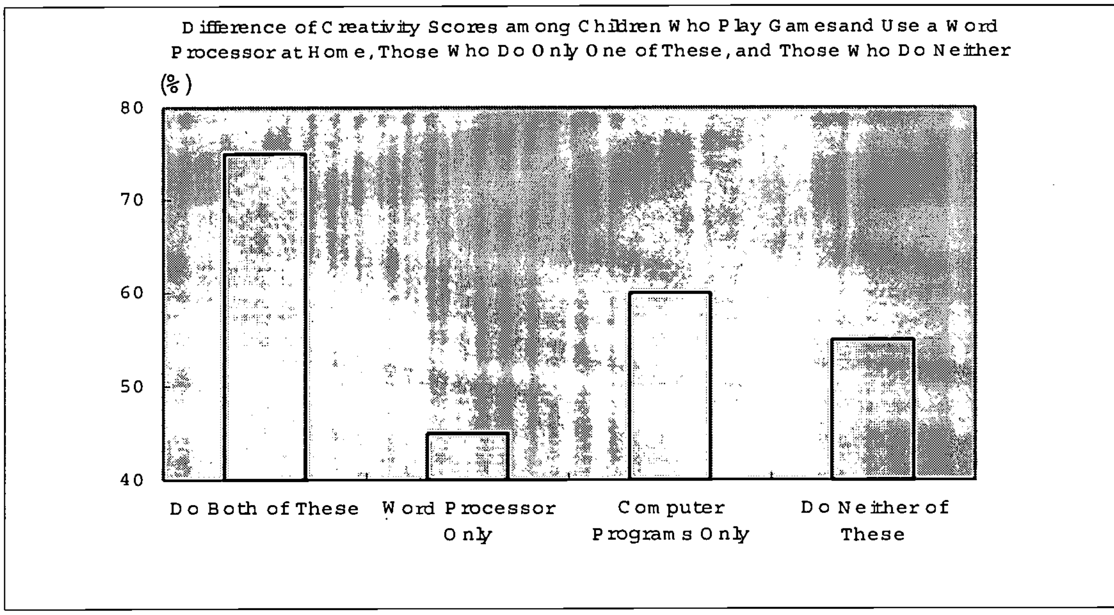


Figure 2 shows the results of the panel survey. Those fifth graders who took many computer lessons showed relatively higher scores in three of the five tests, i.e., the planning, deduction, and space cognition tests, than those who received fewer lessons. Six months later, however, when the same children were in sixth grade, those who received more computer lessons did relatively better in all five tests: planning, deduction, space cognition, induction and meta cognition. Thus, for the fifth graders, the results of the induction and meta cognition tests were not affected by the number of computer lessons taken. In fact, those fifth graders receiving fewer computer lessons actually showed the same or better scores for the two parameters. But by the sixth grade, the results of all five tests were dramatically improved by the use of more computer lessons.

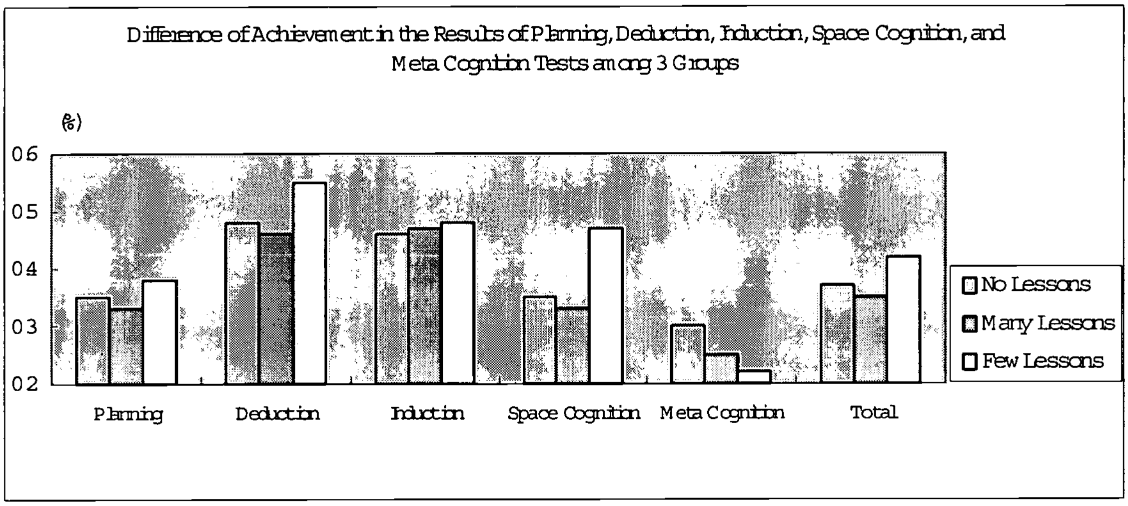
We conducted another creativity test by using the commercial Guilford Test. This survey is a panel conducted at eight-month intervals. The Path analysis showed that computer use improves the deductive ability of elementary school boys. Unfortunately, the same effect was not obtained for junior high school students and elementary school girls. Rather, computer use lowered the creativity of elementary school boys. We may say that junior high school students and elementary school girls, who grow faster than boys, are too old to develop their inductive ability by use of computers. Because elementary school boys use computers based on certain patterns, they develop their deductive ability to apply their way of thinking to different cases. On the other hand, it was assumed that they were unable to develop creativity which required them to organize, edit, and reconstruct information by themselves.

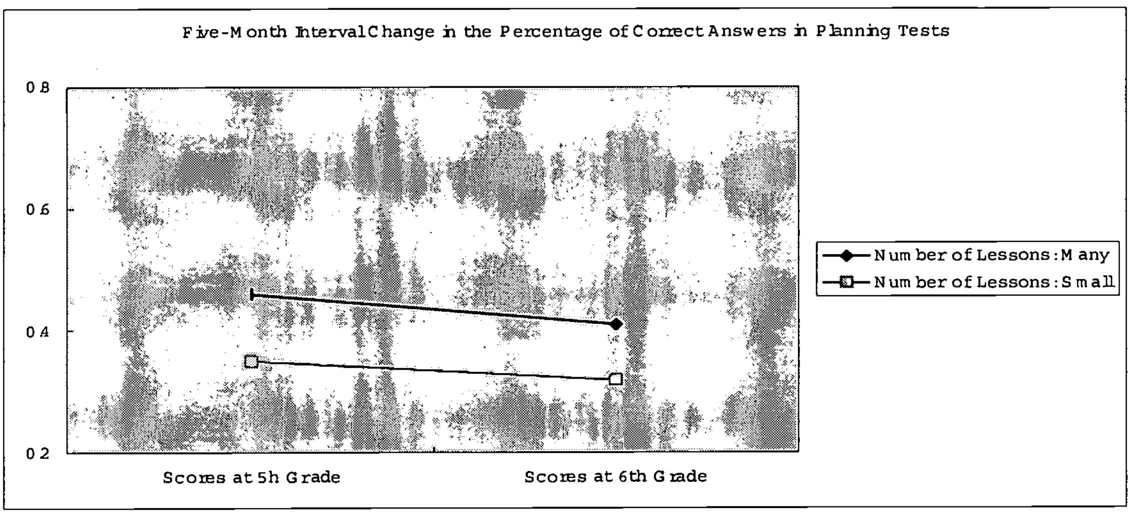
We also conducted a similar panel to discuss whether computer use would affect children's motivation to learn and create at a later date. The panel was for fourth- and fifth-grade boys, and we found that those who originally possess creativity come to use computers more effectively, rather than that computer use develops creativity. This indicates that the use of computers is likely to widen the intellectual gap between those with higher creativity and those with less creativity. In this sense, a computer functions as a gap amplifier, not an equalizer.

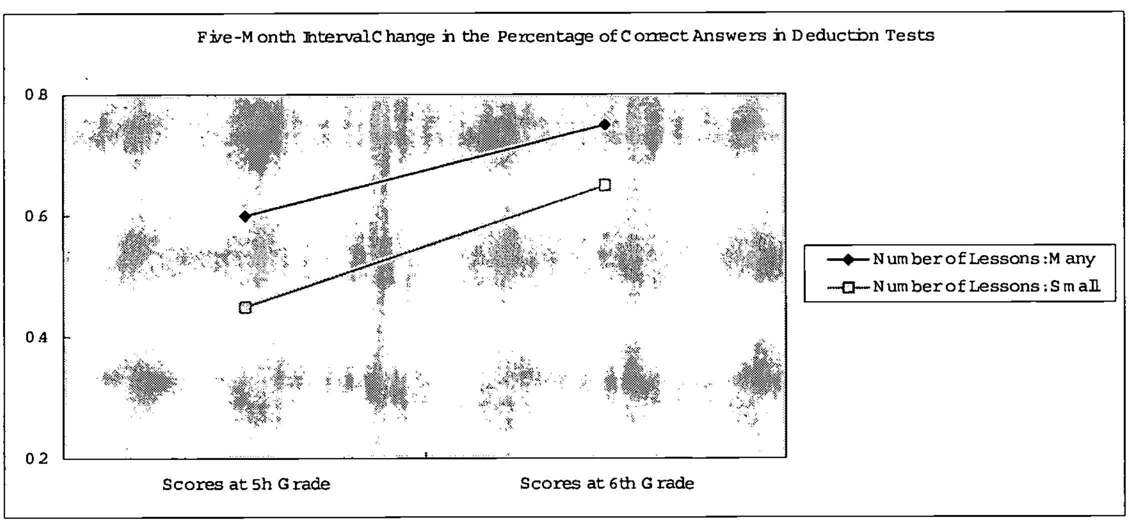
We conducted another panel to investigate how the exploitation of the Internet influences children's information literacy. The panel showed that, for junior high school students, use of the Internet enhanced knowledge and skills relating to the Internet. In terms of information literacy, it was shown that the use of E-mail helps develop the skills of retrieving and selecting appropriate information.

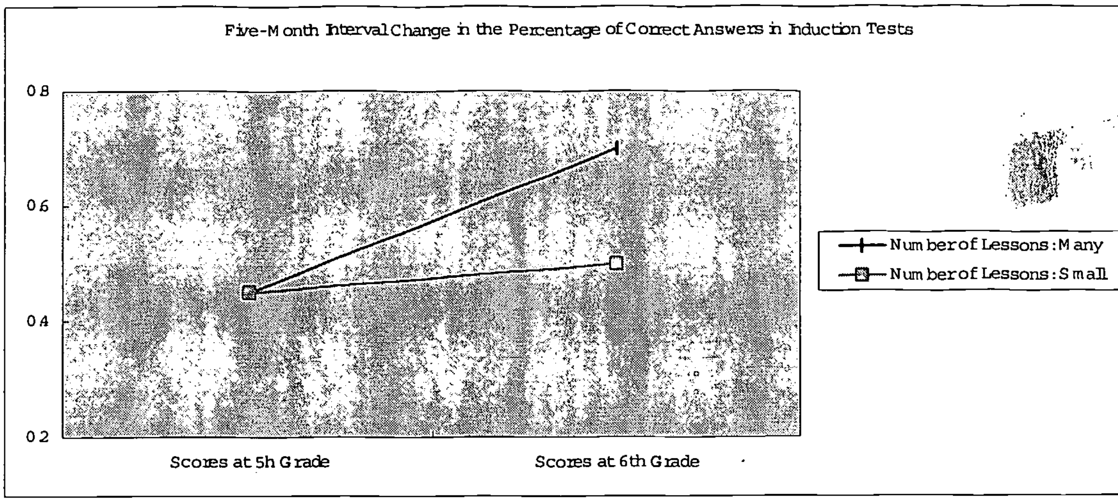
We also conducted research activities from a slightly different perspective, which included work on the effect of MUD (Multi User Dungeon) on education. We found that when we let introversive students behave extroversive in the MUD, the introversive students looked at or spoke to strangers more frequently than those who were given a different computer task for the same number of hours. This study indicates that the experience of using a computer affects even the personality dimensions of the human being.

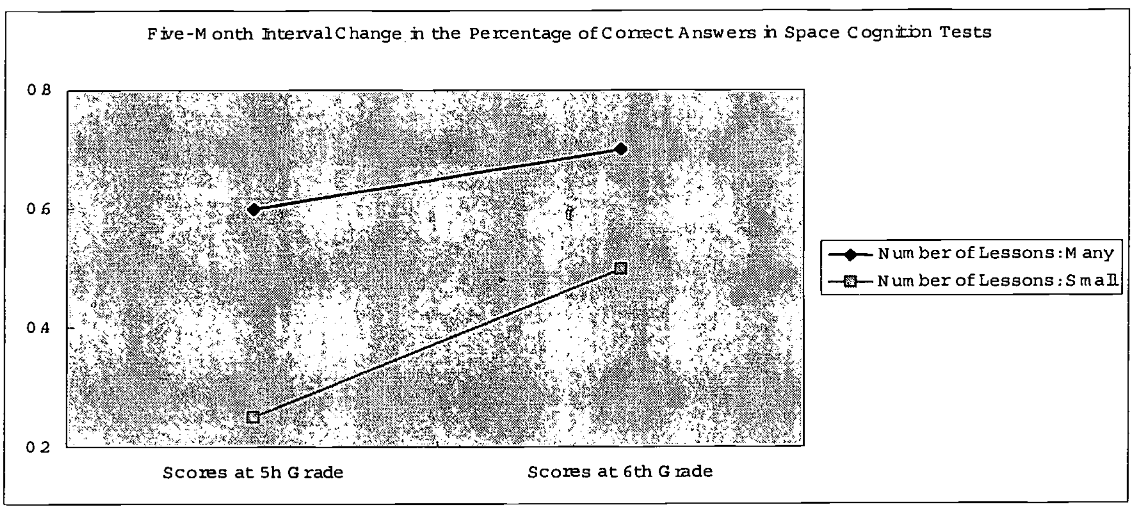
Figure 2. How does the number of computer lessons affect children's intellectual abilities?

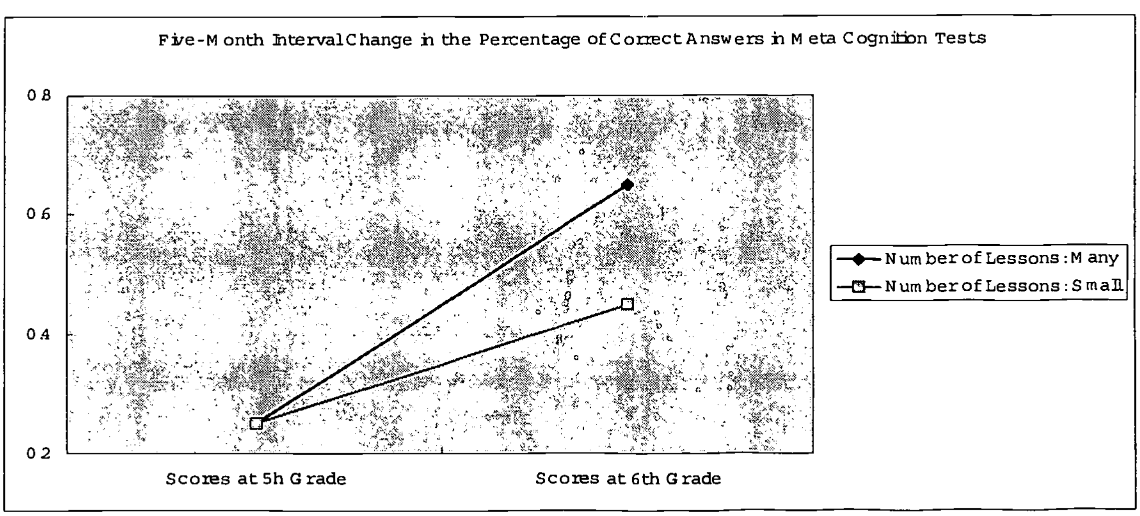







Five-Month Interval Change in the Percentage of Correct Answers in Induction Tests
0.8
0.6
0.4
0.2
Scores at 5h Grade
Scores at 6th Grade
Number of Lessons: Many
Number of Lessons: Small


Five-Month Interval Change in the Percentage of Correct Answers in Space Cognition Tests
0.8
0.6
0.4
0.2
Scores at 5h Grade
Scores at 6th Grade
Number of Lessons: Many
Number of Lessons: Small


Five-Month Interval Change in the Percentage of Correct Answers in Meta Cognition Tests
0.8
0.6
0.4
0.2
Scores at 5h Grade
Scores at 6th Grade
Number of Lessons: Many
Number of Lessons: Small

6. R&D Activities at NIME

NIME also conducts research into how information and communications technologies should be exploited to reform higher education.

To analyze and evaluate broadcast programs, we have developed a system that automatically produces a series of still images taken at specified time intervals from the scenes of a given program. We also produce 600 45-minute programs annually for the University of the Air at NIME studios. The patterns, photographs, illustrations, graphs, etc., which were used for these programs, are incorporated into a still image database.

A recent team investigated the physiologic effects of multimedia by taking measurements on the brain bloodstream and EEG. The results showed that certain acoustic waves of inaudibly high frequency positively influence human physiology. Based on this finding, an industry has released even CDs containing inaudible sound.

Other NIME activities include the use of DVD as a new medium to develop the world's first DVD video instructional material. At present, NIME is developing web-based DVD-ROM instructional materials. But the largest activity of NIME is to operate the Satellite Communications System (SCS), an Inter-university educational exchange system using a communications satellite.

7. Japanese Universities Linked in Space

In July of 1998, a meeting of the Committee for Implementing the Space Collaboration System (SCS) project was held. For the meeting, the National Institute of Multimedia Education (NIME) functioned as a HUB station and 76 VSATs in national universities across the nation from Hokkaido University to The University of Ryukyu were connected via a communications satellite with about five participants at each of the VSAT stations. I assume that approximately 400 people attended the meeting as a whole.

At present, 110 national universities and higher education institutions, and 10 private universities have VSAT stations. Some universities are provided with more than one VSAT station. For example, Kyoto University has four VSAT stations, The University of Tokyo, Hokkaido University, Tohoku University, Nagoya University, and Osaka University have three each.

VSAT stations are generally equipped with two large display screens: one showing the image of a communicating station and the other showing one's own image or the image of a third station now in contact. When a close-up of a speaker's face is shown on the screen, a slight time lag occurs between the movement of the mouth and the voice heard, which may be disconcerting to some people compared with an ordinary TV screen. However, as it is a negligible lag, one can get used to it soon.

An operating desk is equipped with simple terminal devices, which are easily operated by a teacher or an attendant. Every station can transmit images and host events such as lectures, guidance, and conferences as an organizer. An organizing university/institution plays the role of moderator and can call up a station onto the screen. When someone at a receiving station wants to express an opinion, that station just makes a request to speak by touching a panel. However, if that station is not called up by the organizer, its opinion is not heard by others. In this sense, the function of the organizer/moderator is very influential.

We are approaching an era in which undergraduate and postgraduate students select and take courses by their choice from among courses offered by universities through multimedia all across Japan. Those universities having many faculty members chosen by many undergraduate and postgraduate students all around Japan will gain a high repute. Those universities whose teachers are not chosen by other universities' students will be eclipsed as a result. An increasing number of undergraduate and postgraduate students now retrieve information from various sources around the world through the Internet for their studies. They become free from "passive learning" in which students passively osmose their professors' lectures. They search, create, and send out information on their own via networks, receive responses from people around the world, and thereby deepen the level of their studies further. This style of learning is beginning to develop as we enter the age of multimedia and distance education.

University reform has literally been initiated in space.

8. Significance of Exploiting Information Technology for Education

Systems Function

(1) Equalizer and Amplifier

Functionally, information technology provides everyone with an equal opportunity of education. On the one hand, information technology works as an equalizer because it enables everyone to obtain necessary information from all over the world. On the other hand, information technology works as an amplifier because people can collect a larger amount of information in less time by exploiting information technology, rather than by reading books as in the past. However, there is a potential danger that information technology might create a wide gap between those who can collect a large amount of information and those who cannot, and between those who learn fast and those who learn slowly.

(2) Generalization and Specialization

Information technology enables everyone to share information, thus contributing to the generalization of common education. Moreover, it facilitates the systematic collection of specialized information, thereby contributing to specialization of education.

(3) Diversification and Individualization

Information technology diversifies as well as individualizes education. It facilitates the collection of diversified information on law, economy, literature, science, medical science, art, and so on. It also enables learners to learn selectively and develop their own individuality.

Exploitation of Information

(4) Effective Exploitation of Information Sources

Each information source provides unique and distinctive information. Accessing such sources enables us to collect information which would previously have been very difficult to obtain. Schools and educational institutions provide local cultural information or specialized information.

(5) Approach to Excellence

A wide range of excellent information is available. If learners are selective enough, they can approach excellence.

(6) Elimination of Redundant Activities

At the same time that information technology enables one to gather broad information, it also allows one to quickly pinpoint and eliminate duplicated information. Thus concise information can be produced even in distributed, cooperative efforts.

(7) Publication of School Information

Schools can publicize their distinctive features worldwide via school home pages. This is expected to be far more effective, and more ecologically advisable, than distributing brochures within limited areas.

(8) The Ability to Search, Express, and Transmit Information

The repeated experiences of collecting, selecting, editing, creating, and transmitting information by use of information technology are expected to improve students' abilities to search for, express, and transmit information.

(9) Development of Information Literacy

Through the rich experiences of information handling, an information literacy can be developed.

Educational Systems

(10) Emergence of Distinctive Networked Educational Systems Open to Everyone

When all education-related facilities are connected worldwide through networks and provide unique information in the form of databases, home pages, or other means of direct transmission, the whole world will be incorporated into a single networked educational information system. Systems for admission, graduation or qualification acquisition will therefore become more flexible. A society where people are free to maximize their full capabilities for learning will be realized.

Now that the dissemination of information and communications technology enables people to gather information from, and send information to, locations all over the world, one needs to judge how much and what type of information are really necessary. To this end, information senders must make sure that their information is always correct, fair, unbiased, and previously unreported, and must respect the intellectual property rights of others. Information receivers, too, must select information which is correct, fair, unbiased, new, and reliable. And while ideally an international rule would be set to allow the transmission of only desirable information, in practice such a restriction is not feasible. Not only would such a law inevitably be broken, but its very existence would raise questions in regard to the freedom of communications.

It is therefore desirable that a reliable public organization consolidate information useful for education and provide links to such information sources. The services provided by such an organization could, at very least, help keep undesirable information out of the hands of children.

In this sense, such an organization could serve as both a global broker or an editor of excellence and wisdom. If organizations of this sort were established in many locations worldwide in order to moderate the transmission of global information, and if these organization were linked together to work as a team, a global educational information network could be built. Such a network would be connected to education-related home pages of governmental bodies, universities, schools, educational facilities, enterprises, and many other organizations around the world. In the hope of one day realizing such a vast educational resource, I encourage all such organizations to develop their own education-related home pages.

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A Research Agenda for Interactive Learning in the New Millennium

Thomas C. Reeves
Department of Instructional Technology
The University of Georgia
604 Aderhold Hall,
Athens, GA 30602-7144 USA
<treeves@coe.uga.edu>

Abstract: During the past three decades, hundreds of research studies have been conducted to investigate interactive learning in a variety of forms ranging from the earliest days of mainframe-based computer-assisted instruction to contemporary multimedia learning environments accessible via the World Wide Web. In light of this body of research, some researchers believe that we are on the verge of developing a true instructional science whereas others conclude that we simply cannot pile up generalizations fast enough to adapt our interactive designs to the myriad variables inherent in human learning. In this paper, I summarize what we know and what we don't know about interactive learning, describe the strengths and weaknesses of various approaches to interactive learning research, and conclude by proposing a new developmental research agenda for the first decade of the new millennium.

Introduction

WHEN I heard the learn'd astronomer;
When the proofs, the figures, were ranged in columns before me;
When I was shown the charts and the diagrams, to add, divide, and measure them;
When I, sitting, heard the astronomer, where he lectured with much applause
in the lecture-room,
How soon, unaccountable, I became tired and sick;
Till rising and gliding out, I wander'd off by myself,
In the mystical moist night-air, and from time to time,
Look'd up in perfect silence at the stars.
Walt Whitman, Leaves of Grass.

Unlike Walt Whitman's "learn'd astronomer," I offer no proofs, no figures, and nary a chart in this paper. Instead, the paper primarily consists of a logical argument. I desire to persuade you with my argument, and although the phenomenon of interactive learning is hardly as wondrous as the stars, I hope to leave you with a greater appreciation for the importance and complexity of researching interactive learning. More specifically, I attempt to outline what we know about interactive learning as well as what we don't know, and to suggest some directions for a renewed research agenda in the early years of the new millennium. Before proceeding, however, I must reveal some of the biases I bring to this argument and also clarify what I mean by interactive learning.

Almost every field of inquiry today is beset with dichotomous controversies. Consider biology where one camp of scientists is laboring mightily to explain the nature of human behavior on the basis of genetic mapping whereas another camp argues that human behavior will ultimately be explained more completely by the effects of nurture and culture. If research on interactive learning can be regarded as a field (or at least a tiny plot) of inquiry, then it too has its controversies. One of the most obvious is between those who view this enterprise as a branch of science or technology and those who regard it as more akin to a type of craft or even art (Clark & Estes, 1998). I must confess that I have grown increasingly skeptical about the science of designing interactive learning and more attracted to the craft or art of this activity. However, my skepticism concerning learning sciences and educational technology does not preclude a strong commitment to developmental research and evaluation as necessary, but insufficient, methods for collecting information to guide the decisions that must be made when designing (crafting) interactive learning environments.

What is my definition of interactive learning? Burdened by a history of failed technology-based innovations (e.g., programmed instruction, teaching machines, and computer-assisted instruction), the latest buzzwords for interactive learning (e.g., interactive multimedia, the World Wide Web (WWW), and virtual reality) attract both ebullient enthusiasm (Perelman, 1992) and serious skepticism (Postman, 1995). Ultimately, all learning is interactive in the sense that learners interact with content to process, tasks to accomplish, and/or problems to solve. However, in this paper, I refer to a specific meaning of interactive learning as involving some sort of technological mediation between a teacher/designer and a learner. In my view, an interactive learning system requires an electronic device equipped with a microprocessor (e.g., a computer) and at least one human being (a learner). The adult school dropout developing basic literacy skills via a multimedia simulation, the high school student surfing the WWW for archival material about indigenous people to prepare a class presentation, and the three-year old practicing color-matching skills with Big Bird with a *Sesame Street* CD-ROM program are all engaged in interactive learning.

What We Know and Don't Know

There are two major approaches to using interactive learning systems and programs in education. (Although many of the ideas expressed in this paper may apply within training contexts, this paper will be limited to research from and implications for education.) First, people can learn "from" interactive learning systems and programs, and second, they can learn "with" interactive learning tools. Learning "from" interactive learning systems is often referred to in terms such as computer-based instruction or integrated learning systems (ILS). Learning "with" interactive software programs, on the other hand, is referred to in terms such as cognitive tools and constructivist learning environments.

The foundation for the use of interactive learning systems as "tutors" (the "from" approach) is "educational communications theory," or the deliberate and intentional act of communicating content to students with the assumption that they will learn something "from" these communications. The instructional processes inherent in the "from" approach to using interactive learning systems can be reduced to four simple steps:
1) exposing learners to messages encoded in media and delivered via an interactive technology,
2) assuming that learners perceive and encode these messages,
3) requiring a response to indicate that messages have been received, and
4) providing feedback as to the adequacy of the response.

The findings concerning the impact of interactive learning systems and programs can be summed up as:
- Computers as tutors have positive effects on learning as measured by standardized achievement tests, are more motivating for students, are accepted by more teachers than other technologies, and are widely supported by administrators, parents, politicians, and the public in general.
- Students are able to complete a given set of educational objectives in less time with CBI than needed in more traditional approaches.
- Limited research and evaluation studies indicate that integrated learning systems (ILS) are effective forms of CBI which are quite likely to play an even larger role in classrooms in the foreseeable future.
- Intelligent tutoring systems have not had significant impact on mainstream education because of technical difficulties inherent in building student models and facilitating human-like communications.
- Overall, the differences that have been found between interactive learning systems as tutors and human teachers have been modest and inconsistent. It appears that the larger value of these systems as tutors rests in their capacity to motivate students, increase equity of access, and reduce the time needed to accomplish a given set of objectives.

The foundation for the use of interactive learning systems as "cognitive tools" (the "with" approach) is "cognitive psychology." Computer-based cognitive tools have been intentionally adapted or developed to function as intellectual partners to enable and facilitate critical thinking and higher order learning.

Examples of cognitive tools include: databases, spreadsheets, semantic networks, expert systems, communications software such as teleconferencing programs, on-line collaborative knowledge construction environments, multimedia/ hypermedia construction software, and computer programming languages. In the cognitive tools approach, interactive tools are given directly to learners to use for representing and expressing what they know (Jonassen & Reeves, 1996). Learners themselves function as designers, using software programs as tools for analyzing the world, accessing and interpreting information, organizing their personal knowledge, and representing what they know to others.

The basic principles that guide the use of interactive software programs as cognitive tools for teaching and learning are:

- Cognitive tools will have their greatest effectiveness when they are applied within constructivist learning environments.
- Cognitive tools empower learners to design their own representations of knowledge rather than absorbing representations preconceived by others.
- Cognitive tools can be used to support the deep reflective thinking that is necessary for meaningful learning.
- Cognitive tools have two kinds of important cognitive effects, those which are *with* the technology in terms of intellectual partnerships and those that are *of* the technology in terms of the cognitive residue that remains after the tools are used.
- Cognitive tools enable mindful, challenging learning rather than the effortless learning promised but rarely realized by other instructional innovations.
- The source of the tasks or problems to which cognitive tools are applied should be learners, guided by teachers and other resources in the learning environment.
- Ideally, tasks or problems for the application of cognitive tools will be situated in realistic contexts with results that are personally meaningful for learners.
- Using multimedia construction programs as cognitive tools engages many skills in learners such as: project management skills, research skills, organization and representation skills, presentation skills, and reflection skills.
- Research concerning the effectiveness of constructivist learning environments such as microworlds, classroom-based learning environments, and virtual, collaborative environments show positive results across a wide range of indicators.

In summary, thirty years of educational research indicates that various interactive technologies are effective in education as phenomena to learn both "from" and "with." Historically, the learning "from" or tutorial approaches have received the most attention and funding, but the "with" or cognitive tool approaches are the focus of more interest and investment than ever before. Preliminary findings suggest that in the long run, constructivist approaches to applying media and technology may have more potential to enhance teaching and learning than instructivist models (Jonassen & Reeves, 1996). In other words, the real power of interactive learning to improve achievement and performance may only be realized when people actively use computers as cognitive tools rather than simply interact with them as tutors or data repositories.

At the same time, there is a paucity of empirical evidence that interactive learning technologies are any more effective than other instructional approaches. This is because most research studies confound media and methods. Sixteen years ago, Richard E. Clark ignited a debate about the impact of media and technology on learning with the provocative statement that "media do not influence learning under any conditions" (Clark, 1983, p. 445). He clarified this challenge by explaining that media and technology are merely vehicles that deliver instructional methods, and that it is instructional methods, the teaching tasks and student activities, that account for learning. Clark maintained that as vehicles, interactive technologies such as computer-based instruction do not influence student achievement any more than the truck that deliver groceries changes our nutrition. Clark (1994) concluded that media and technology could be used to make learning more efficient (enable students to learn faster), more economical (save costs), and/or more equitable (increase access for those with special needs).

Robert Kozma challenged Clark in the debate about the impact of media and technology on learning by arguing that Clark's separation of media and methods creates "an unnecessary and undesirable schism between the two" (Kozma, 1994, p. 16). He recommended that we move away from the questions about whether technologies impact learning to questions concerning the ways can we use the capabilities of interactive technology to influence learning for particular students with specific tasks in distinct contexts. Kozma recognized that although interactive technologies may be essentially delivery vehicles for pedagogical dimensions, some vehicles are better at enabling specific instructional designs than others.

Both Clark and Kozma present important ideas. It is evident that the instructional methods students experience and the tasks they perform matter most in learning. In addition, I maintain that the search for unique learning effects from particular interactive technologies is ultimately futile. After all, fifty years of media and technology comparison studies have indicated no significant differences in most instances. Whatever differences are found can usually be explained by differences in instructional design, novelty effects, or other factors. However, even though technologies may lack unique instructional effects, some educational objectives are more easily achieved with interactive learning than in other ways. Revealing effective implementations of interactive learning for various types of learners and discrete learning objectives and content is an important goal for educational researchers and evaluators.

A Renewed Research Agenda

The fact that educational research is not highly valued by educational practitioners is widely recognized. A large part of the problem can be attributed to the fact that the interests of academics who conduct research and those of administrators, teachers, students, parents, and others involved in the educational enterprise are often quite different. Tanner (1998) reminds us that educational research should be focused on the mission of enhancing educational opportunities and outcomes:

> *Unfortunately, much that is taken for social research serves no social purpose other than to embellish reputations in the citadels of academe and sometimes to even undermine the democratic public interest.... Early in this century, John Dewey warned that educational practices must be the source of the ultimate problems to be investigated if we are to build a science of education. We may draw from the behavioral sciences, but the behavioral sciences do not define the educational problems. The faculties of the professional schools draw on the basic sciences, but their mandate is mission-oriented, not disciplined centered. (p. 348-349)*

As noted in the previous section, research reveals that students learn both *from* and *with* interactive learning technology. Computer-based instruction and integrated learning systems have been demonstrated to be effective and efficient tutors, and there is considerable evidence that learners develop critical thinking skills as authors, designers, and constructors of multimedia or as active participants in constructivist learning environments. Unfortunately, the level of our knowledge about interactive learning is somewhat analogous to what health practitioners know about the functions of vitamins and herbs in supporting good health. There is general agreement within the healthcare professions that most vitamins and many herbs have health benefits, but there is considerable disagreement about the proper dosages, regimens, and protocols for using various products. Similarly, in education, while we can and do generally agree that interactive learning is good, we know very little about the most effective ways to implement interactive learning. In fact, the need for long-term, intensive research and evaluation studies focused on the mission of improving teaching and learning through interactive learning technology has never been greater. Both government and commercial interests are pushing interactive learning in various forms from preschool through lifelong learning, and major decisions are being made about these technologies based upon habit, intuition, prejudice, marketing, politics, greed, and ignorance rather than reliable and valid evidence provided by research and evaluation.

As we enter the new millennium, I maintain that our research and evaluation efforts should be primarily developmental in nature, i.e., focused on the invention and improvement of creative approaches to enhancing human communication, learning, and performance through the use of interactive learning technologies. The purpose of such inquiry should be to improve, not to prove. Further, developmental research and evaluation should not be limited to any one methodology. Any approach, quantitative, qualitative, critical, and/or mixed methods, is legitimate as long as the goal is to enhance education.

My recommendation to engage and invest in developmental research and evaluation overlaps somewhat with advice emanating from policy-makers in the USA where the Panel on Educational Technology of the President's Committee of Advisors on Science and Technology (1997) established three priorities for future research:

1. Basic research in various learning-related disciplines and fundamental work on various educationally relevant technologies.
2. Early-stage research aimed at developing new forms of educational software, content, and technology-enabled pedagogy.
3. Empirical studies designed to determine which approaches to the use of technology are in fact most effective. (p. 38)

The second of these priorities reflects my call for development research issued above. However, I believe that the President's Committee of Advisors on Science and Technology (1997) has placed too much faith in the ability of large-scale empirical studies to identify the most effective approaches to using interactive learning in schools. In the final analysis, the esoteric and complex nature of human learning may mean that there may be no generalizable "best" approach to using interactive learning technology in education. The most we may be able to hope for is more creative application and better informed practice.

Conclusion

Salomon (1991) describes the contrast between analytic and systemic approaches to research that transcends the "basic versus applied" or "quantitative versus qualitative" arguments that so often dominate debates about the relevancy of educational research. Salomon concludes that the analytic and systemic approaches are complementary, arguing that "the analytic approach capitalizes on precision while the systemic approach capitalizes on authenticity" (p. 16). Salomon's critique remains relevant because much of the research and evaluation of the effectiveness of CBI and other forms of interactive learning continues to be plagued by fundamental flaws that render much of this literature little more than pseudoscience (Reeves, 1993).

One reason for this deplorable state of affairs is that there has long been great disagreement about the purpose and value of educational research. For example, Nate Gage, a past president of the American Educational Research Association (AERA), has been a staunch defender of the notion that the goal of basic research in education is simply "more valid and more positive conclusions" (Farley, 1982, p. 12) whereas another past president of AERA, Robert Ebel, proclaimed:

....the value of basic research in education is severely limited, and here is the reason. The process of education is not a natural phenomenon of the kind that has sometimes rewarded scientific investigation. It is not one of the givens in our universe. It is man-made, designed to serve our needs. It is not governed by any natural laws. It is not in need of research to find out how *it works. It is in need of creative invention to* make *it work better. (Farley, 1982, p. 18, Ebel's italics).*

Should researchers and evaluators seek to establish immutable laws akin to those found in the harder sciences? Or should we be focused on finding out how to improve education with different types of students in specific places at particular times of their development? These questions reflect an on-going struggle between those who view our field as a science and those who regard it as a craft. The questions also reflect the so-called "paradigm wars" among educational researchers. Despite the increased acceptance in some educational circles of qualitative alternatives to the experimental methods that have dominated educational research in the past, there are signs that some powerful policy-makers are still pushing for more classically empirical approaches. The aforementioned Panel on Educational Technology of the President's Committee of Advisors on Science and Technology (1997) listed as one of its six major strategic recommendations that the government "initiate a major program of experimental research....to ensure both the efficacy and cost-effectiveness of technology use within our nation's schools" (p. 5). I contend that a wiser course would be to support more development research (aimed at making interactive learning work better) using a wider range of quantitative, qualitative, critical, and mixed methods and less empirical research (aimed at determining how interactive learning works) using experimental designs.

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2. This paper reflects my preliminary (and admittedly hurried) thinking about what I shall eventually present at the conference in Seattle. Please don't be surprised if I radically change the ideas presented in this paper when I actually give the keynote address. As Michelangelo said, "I am still learning."

INVITED SPEAKERS

Utilizing Disruptive Technologies in the University: Confessions of an Agent Provocateur

Terry Anderson, Ph.D.
Academic Technologies for Learning
University of Alberta, Canada
terry.anderson@ualberta.ca

Abstract: This paper overviews the programming and facilities at a large research University that is designed to assist faculty in maximizing their effective use of educational technologies. Different programs developed by a university-wide "new media center" are described and critiqued. The paper overviews the challenges that the University has in utilizing "disruptive technologies" and in developing models of enhanced teaching and learning that are cost and learning effective.

Introduction

This paper overviews the experiences and reflections of one employed by a major research university as a change agent, tasked with making sure the University does something about all this "education technology and distance education stuff"! In 1994 I was hired as one faculty member in a University with over 1800 full-time tenure-track academics charged to "change the world" - my only weapon a "title" - I was the Alternative Delivery Specialist. Fortunately, no one in 1994, nor today, knew what an alternative delivery specialist is supposed to do, leaving me with much freedom. In fact, the only ones who seemed to have a clear conception of what an alternative delivery specialist was, were obstetricians in the Faculty of Medicine who thought I represented yet another brand of mid-wife attempting to usurp their monopoly in the child birth business.

Five years later, some progress has been made and the sky has not fallen, the University has not gone bankrupt, has not been deserted by students, nor has it replaced all the instructors with teaching bots. Yet it is paradoxical that, as organizations based in information and knowledge acquisition and development, universities have not flourished in the so-called Age of Information. In fact I hear as much doom and gloom and regrets for the passing of the good old days as I hear optimistic excitement about the opportunities available to us at the start of a new millennium.

Why have information and communications technologies had so little impact on teaching and learning within the mainstream university? I believe that this is the case because, unlike the sustaining technologies used to support and enhance the *research* and *administrative* components of the University, *instructional* technologies are disruptive to the current culture and economics of higher education. Therefore, I believe that divergent strategies must be employed to ensure that the University adopts and exploits not only the sustaining technologies that will help us improve on our present practices, but also the disruptive technologies that will move us forward into the emerging new paradigm of instruction and learning in higher education.

In this paper I will trace the development of programs and staffing in a university "new media center" (http://www.atl.ualberta.ca) and try to identify those factors in programming that succeed in enticing faculty and administration to make both adaptive and proactive changes. Finally, I'll suggest strategies and means by which the central core of the academic community can be induced to use information and technology tools to protect and advance the fundamental values of the academic community.

Context and Challenges

Reid (1997) situates in time the information and communications context in which we live. Although universities were in the forefront of development of the Net in the "before commercialization" and "novelty" stages, we have been relatively less active as a presence in the "utility" stage and will be even less conspicuous in the "ubiquity" phase as commercial and public entertainment uses far eclipse our development and application endeavors on the Net. We are great inventors and tinkerers; our challenge is to leverage this tinkering into the core business of our academy. Greg Baroni, manager of KPMG's global education practice, states that "Universities are sitting at the gateway of the knowledge economy. The question is, will they leverage their intellectual capital or become a vestige of the past, talking about the way things used to be?" (from Woody,1998). There are many who think we do not have the drive, speed, or determination to recreate ourselves for a networked learning environment. I disagree. While we have many barriers to overcome, there are options open to us through which we can leverage and support our institutions and our faculty to overcome these barriers.

The list of challenges and threats to the modern University is large and growing -more students, widening disparity in prerequisite training and skills, increased demands for access and lifelong learning, increasing expectations from business, higher government expectations of reduced operating costs, productivity gaps - the list goes on and on. It has become apparent that the University cannot be all things to all people. Vest 1995 quotes an American university president's description of the modern research university as " Overextended, Under-focused; Overstressed, Under-funded " (Vest, in Clark 1995.p.146). These pressures result in a shortage of qualified academics willing to take on the challenge of leading our institutions at a time when that leadership is most needed, a tendency to develop a siege mentality, and a search for a technological quick fix to solve our complex problems.

When I talk to my colleagues on campus I have learned to expunge from my vocabulary words like market-share, customer and of course the *profit* word. But I hope you'll allow me to describe the market context for universities in Alberta, and, I suspect, similar market contexts in most of North America. In Alberta last year there was an increase of 4.8% in full-time undergraduate enrollments - and an increase of 10.3 % part time enrollments (Statistics Canada, Center for Educational Statistics, Nov. 10, 1998). Among the G8 industrialized countries, Canada enrolls the highest percentage of its citizens in higher education We have obviously moved from systems designed for the elite to mass systems of higher education for life-long learners.

In the USA, Clifford Aelman (1999) develops scenarios based upon increased numbers of high school graduates, increasing numbers of older, part time students, and increased participation by traditionally disadvantaged population groups, all of which translate to an increase in enrolment of between 23% and 40% during the next decade.

Our context, then, is not one of a great threat of having no students at the front door - quite the opposite, they will be lined up beating on that door. Our challenge is, while helping our institutions to increase capacity using traditional on-campus delivery systems, to get them to pay attention to opportunities to increase capacity through development of non-traditional and off campus programming. Why worry about students struggling to get in at the back door, when there are line ups at the front door?

A critical accomplishment of my first year at the University was the initial funding to establish a multi-media production studio. This facility was designed to assist faculty in developing innovative, technology based enhancements to their teaching. (see http://www.atl.ualberta.ca). It soon became apparent that we needed to develop a set of pedagogical, economic and technical models to guide the development of educational content and professional development programming in our unit..

Models of Courseware Development

There are at least 3 theories of educational software production. The first I'll call the *"drop off your ideas and come back in a few months and pick up the CD"* model. In this model academics are used as subject matter experts and the school or business lines up a team of experts including instructional designers, graphic artists, video producers and programmers. This is a model that commercial software houses use and with very few exceptions have been losing money at for the past 5 years. The production quality is generally excellent, some have even paid attention to pedagogical principles and to interface design. What the model fails to address is the customer - in this case the busy faculty member with the power to assign the purchase of the product to hundreds of undergraduates. This model strives to create such superior product that faculty will be compelled to assign it as compulsory tool in every class. But it doesn't address the issues of trailability, observability, and compatibility that are critical to adoption of any innovation (Rogers, 1995). How are professors to use a $80.00 CD when they already have a good text book, their lab or seminar topics all mapped out, and a niggling fear that if they do assign the CD only a handful of students will actually purchase it and worse maybe they will decide not to come to the lectures.

The second model was labeled by my friend Tony Bates from the University of British Columbia as the "*Lone Ranger and Tonto*" model. In this model a single faculty member, with a trusty graduate student, embarks solo on the development task. Single handedly, they master not only the content and instructional design of the discipline, but also the complete production process, including sales, marketing, finance and eventual retirement to a condo in Maui. We've played with this model and had some limited success. One faculty member developed a CD of rotateable, high resolution images of his mineral collection, which allows students to zoom in examine a host of minerals without having to touch or even breath on his lifelong rock collection. Unfortunately, he hasn't got the cash for the condo, yet as every potential publisher I introduce to him, walks away with at least an order of magnitude difference in assessment of the appropriate amount of royalty payments that should flow to the professor. Another relative success (morally if not economically) is the Healthy Student Shareware collection that we've developed. This is a serious of seven Authorware based tutorials on issues such as managing Stress, Nutrition, Booze and sexually transmitted diseases. We've installed these programs in kiosks around campus and given them away via FTP all across the world. This model can work, but requires a commitment, skill set and entrepreneurial bent that is only rarely found among academics.

The third model I'll call the "*teach 'em to fish model*" in which instructional and technical experts guide and assist faculty members with the special skills needed and through a scaffolding and training model, help faculty to create and maintain their own teaching resources. We implement this model through an annual competition for seats in our production studio. We pay for full course release for a faculty members and "immerse" them in the collaborative production of HTML, instructional design, www sites, Authorware tutorials, problem based learning scenarios and other innovative instructional approaches. We continue this program today because we see this as a necessary, long-term investment in our faculty.

Besides these differing models of content development, we've also developed various professional development programs during the past 5 years which I will classify according to those that have worked, those that have not and those we're not sure about.

Initiatives That Work

Partners Program This is our full teaching release, "come live in the production center" model of faculty development. The opportunity to work along side skilled peers and professional developers for an extended period of time is one of the few ways that we have seen truly transformative change in approaches to teaching and learning among our faculty. Although we realize that the long term answer to faculty empowerment, lies in the use and development of these tools, not in central development centers, but in the faculties, we also realize the benefits of immersion in a community of developers and the older tradition of providing a sanctuary for academics to develop their best work.

Training, Infrastructure and Empowerment System (TIES): Mike Szabo has led a two year project at our university that empowers task forces at the department level to create a vision and skillfully chart a plan of action for their faculty, while engaged in a learning process focussed not only on technical skill development, but also on the critical skills of change management (see http://www.quasar.ualberta.ca/DRMIKE/ties.html). Since the real business of the University -teaching and research happens at the departmental level, it is here that real change and innovation must be embraced. If the department based units ignore or oppose innovative developments then life at the University proceeds un-affected. "For change to take hold, one department and faculty after another needs itself to become an entrepreneurial unit, reaching more strongly to the outside with new programs and relationships and promoting third-stream incomes" (Clark,1997.p.7)

Decentralized, Discipline Related Support Centers: The support of faculty based development and support centers is a challenging task for the director of a centrally funded unit. However, I think the change process is so large, so complicated and in many ways specific to the context of the discipline that it is only when individual departments and faculties grapple with the issues themselves that real change happens. Our challenge is developing a central unit that coordinates, trains, and communicates amongst these units and maintains very specialized tools and expertise that can be used cost effectively to support these distributed development centers.

Student Guides And Tech Helpers: I don't think we have been as successful as we could have been in employing students as technical assistants, but I agree with Steve Gilbert (Gilbert, 1997) who writes that one of the few economical solutions to the "crisis of support" in technology assisted higher learning is in mobilizing our student body to provide assistance not only to other students but to faculty as well.

Pushed Mailing lists: The single most effective tool we have developed to engage and inform faculty has been our unmoderated Majordomo discussion list. We now have over 500 faculty on ATLNet, providing a forum for not only announcements but also for healthy debate and discussion. I've learned many lessons through management of this list including the need to limit membership to our faculty, to archive messages in WWW format (http://www.ualberta.ca/htbin/lwgate/atlnet/archives/) and unobtrusively regulate the traffic so as to reduce superfluous messages.

Things That Didn't Work Very Well

High Cost, Full Scale, Commercial Multimedia Content Development: We are in the midst of a very large scale multimedia development that is excellent technical and pedagogical product. However, I find it difficult to rationalize the inordinate amount of support that is required to sustain these developments. We have not been as successful as I would have liked in attracting support of major publishing houses. Despite Bill Gates assertion that "content is king" the core business of the University is in creating the context for learning, not in sustaining high risk, large scale content development. There may be "big money" in this type of development in the future, but it is too much like buying lottery tickets as a retirement planning scheme for my liking.

Lone Ranger Production Of Multi-Media Content: As I mentioned, we have had some pretty spectacular results from talented lone rangers (for example David Miall's excellent CD-ROM on Romanticism http://www.ualberta.ca/~dmiall/ROMCDINF.HTM) but this is model that only supports the early adopters, and we are after much more profound change within the academy then can be engineered through the heroic efforts of individual faculty members.

On-Going Professional Development Computer Conferences: I like computer conferencing for courses and short term virtual conferences, in fact I lay modest claim to having organized the first international virtual conference organized on the Internet in 1992 (Anderson and Mason,1994). However, the medium is inherently a pull technology, that relies on busy academics to make a special effort to adapt to and frequently logon to another environment. Our conferencing system, is full of conferences that petered out days or weeks after the enthusiastic startup by our training or development groups.

Production Of Print Based "Training Manuals": We joined in a consortium to produce a series of 27 training manuals for faculty development http://www.gmcc.ab.ca/users/imd/etpdp/sample/programmap.htm. The quality was high, the format professional - but our faculty just wasn't interested. We're now converting them to WWW however I still don't expect faculty to systematically go through the materials. At least on the WWW they will be available "just in time".

Individual Faculty Member Based Distance Education Initiatives I know this will sound very naive to distance educators, but in our desire to support the innovation of individual faculty, we have sometimes funded development of projects that died instantly when the individual faculty member got tired, retired, relocated or died. Education, and especially that designed for distance delivery requires a support system, starting at the chair and dean and moving right through to the registrar and all the way to the janitorial staff.

Forced Change: Ever tried to herd 3 cats - how about 1800? Enough said.

Ones I'm Not Sure About

Large Volume, Scattergun Staff Training Programs During the past term our staff hosted a training or professional development event every day (see http://www.atl.ualberta.ca/training/) Some were well attended, some weren't. We succeeded in burning out some staff members, attracting many of the same faces day after day, but made progress towards eliminating the two of the top eight barriers to adoption identified by faculty in our campus needs assessment survey (Anderson, Varnhagen and Campbell, 1998) – those being related to lack of knowledge and exposure to new instructional technologies.

WWW Contests We have run contests for the best web supported courses in a variety of categories during the past two years (see http://www.atl.ualberta.ca/cyc/home.cfm). We had over 70 entrants this year and gave away $8,000 in prizes, but I think we intimidated the majority faculty leaving the spoils of victory exclusively to the early adopters - no longer our major target group.

Strategic Planning And Long Term Technology Integration Plans I've spent far too many meetings this past year working on university and departmental Technology Integration Plans. I find it very difficult to develop plans that do not result in requests to the president for funding an order of magnitude or two above the capacity of the institution - thus creating documents with high potential for dust gathering. However, I remain convinced that planning that supports and allows for innovation is of critical importance to the evolving University.

I've tried to outline the challenges and accomplishments and failures of the past 5 years at our University and hope that you can draw some reflective parallels to your own context. I invite you to check out the URLs above to investigate any of these innovations in greater detail. I'd like to turn now to a bit more philosophical analysis of the change process.

The Teaching Professional

Many of you have probably read the article Digital Diploma Mills by David Noble (another powerful writer and Canadian scholar and academic most definitely, not in the tradition of Marshall McLuhan). Noble and others neo-Luddites lament the "commodification of knowledge" the displacement of control and ownership of intellectual property coupled with a supposed de-professionalism of academics as teachers. I'll return to the issue of economics later, but let me comment on academics as professional teachers. I'm not sure who first coined the axiom that "any teacher who can be replaced by a machine should be" but let me tell you that such cliches do not go over well in our Faculty Club. Many see machines as de-skilling professors and as I mentioned leading to the de-professionalisation of academics. What does it mean to be a professional? Applebaum & Lawton (1990) define a profession as having the following characteristics:

- Organized to serve a specialized body of knowledge in the interests of society
- A set of skills proficiencies, techniques and competencies
- Standards of excellence, self regulation, training of new members
- Established means of professional communications (journals and meetings)

Are professors at institutions of higher education professional teachers? Do professors at research universities maintain a "specialized body of knowledge in the interests of society" Of course they do, but it is the knowledge of a discipline, of research, of knowledge creation, it is not a specialized knowledge of teaching and learning. Do we have standards of excellence, training of new members, established means of professional communications? Again certainly within the discipline, but not with the profession of teaching.

I challenge you to undertake a piece of research when you get back to your campus. Go to your library catalog and do a search within any of the subject matter domains. Search for those periodicals, journals, meetings notes, training manuals or any other documentation supporting the development and growth, not of research within the discipline, but of research relating to the teaching of that discipline.

Let me tell you what I found from researching our own Faculty of Engineering, which is arguably one of Canada's finest faculties - based upon reputation, awards and success of graduates. This faculty has over 190 tenure or tenure track academics and over 4,000 students at undergraduate and graduate levels. I looked up how many Journals or periodicals we subscribed to that focused on the science, specialized knowledge, self regulation or training of faculty to the profession of engineering teachers. I found that there is a listing for *Engineering Education* the Journal of the American Society for Engineering Education. We have some volumes going back to 1898 in our holdings, but we dropped our subscription in 1991! We also have a few old volumes of the European Journal of Engineering Education but dropped the subscription in 1991 as well. Let's put this in perspective. Our same library catalog lists 207 periodical publications under chemical engineering and even 24 periodical titles under "low-temperature engineering". I realize that living in Northern Canada might justify a special interest in low-temperature engineering. But we subscribe to 24 periodicals on low-temperature engineering and not a single active subscription to the core business of the Engineering faculty - that of teaching and promoting learning - hardly professional.

What do I conclude? There is absolutely no danger, as Noble and others claim, that technology will deprofessionalize our teaching faculty. The fact is they are not professional teachers and probably never have been- professional researchers, scientists yes - but teachers no.

So what you might ask? It is interesting that Phoenix University, the fastest growing and I believe first University to be publicly traded on the Nasdec exchange, with 1997 profits to share holders of $33 million, boasts that none of their faculty (99.4% of whom are part time adjunct) are professional researchers - they are trained, guided and evaluated as professional teachers (Winston, 1999, p. 13). We boast that over 90% of our teaching are full time academics and researchers. Somewhat of a disconnect, I would say. Many of my colleagues argue that a research university doesn't need to worry about this, in that we focus on research, which defines our market niche. We are finding now in international education that we are competing with real professional teachers and researchers and I fear that our ability to compete will be compromised unless we find ways of rewarding faculty, within the research university, for expending the necessary energy and time to development excellence as professional teachers. Murry Turoff, one of the earliest developers of on-line courses, makes the case that ""Competition in education on an international and national basis will become the principle determinant of the success or failure of institutions in the next decade" (Turoff, 1999 p.30)

Why is it so difficult for us to embrace the technologies that are specifically designed to aid the core business of our Universities in teaching and learning? A key to understanding this is to differentiate these technologies between those that are sustaining and those that are disruptive of the social context in which our institutions were conceived and have evolved.

DISRUPTIVE AND SUSTAINING TECHNOLOGIES from (Archer, Garrison and Anderson, in press)

Universities currently enjoy a dominant position in the post-secondary education "industry." However, this "industry" is entering a period of rapid technological change – the sort of period in which the leading firms in an industry may rather suddenly be eclipsed by new players. In other words, the next few years could see a sudden change for the worse in universities' position in an educational marketplace being transformed by new technologies.

According to Christensen (1997), the main reason that successful and apparently well run organizations can and do flounder is that they fail to recognize the distinction between *sustaining* technologies and *disruptive* technologies. Sustaining technologies are those that improve the performance of established products. They are often developed by successful companies, the leaders in their fields, for and in close collaboration with their most important and lucrative clients. In other words, failures are often the result of successful firms' following the commendable business practice of listening closely to their customers.

In contrast to sustaining technologies, which improve the performance of established products, disruptive technologies often result in *worse product performance in the mainstream market*, at least in the short run. But they have other features that fringe (and generally new) customers value. Products based on disruptive technologies are typically cheaper, simpler, smaller, and, frequently, more convenient to use." Christensen, (p. xv) Generally disruptive technology based delivery systems are used to address new types or sectors of learners. Often professional development groups, or students not generally in a position to take advantage of residence based courses.

The innovator's task is to ensure that this innovation – the disruptive technology that doesn't make sense – is taken seriously within the company without putting at risk the needs of present customers who provide profit and growth. (p. xxiv) This requires that the development of niche markets that are protected from the demands and constraints of the main business activity of the day. It also requires a research and development capacity within the organization that can test, fail and recover very quickly from experimentation with the disruptive technology in small scale, but exemplar

So how should one direct the development focus and energy of a modern research university? In an interesting paper, Dan Surry (1997), differentiates between developers with a determinist philosophy related to technology and those who view development from an instrumentalist lens (Table 1.). Deterministic developers are convinced that technological change is inevitable and driven by the superior product and process that results in education from the use of new technologies. They focus on the product itself, seeking the "killer ap" that either increases speed, effectiveness or efficiency of the teaching/learning process. They see institutions as largely disorganized and ill-structured obstacles to the types of supportive environments necessary for faculty to develop and use technologies effectively. They seek to minimize the deterious effects of the context so as to allow the inherent technological superiority of the product to manifest itself.

PHILOSOPHY	GOAL Systematic Change (Macro)	Product Utilization (Micro)
Developer (Determinist)	Focus on the structure and establishment of a effective organizational framework	Focus on process of designing developing, and evaluating effective instructional products.
Adopter (Instrumentalist)	Focus on the social, political and professional environment in specific organizations	Focus on the needs and opinions of potential adopters and characteristics of the adoption site.

Table 1. Overview of Instructional Technology Diffusion Theories showing diffusion goal and philosophical view. From Surry (1997)

Instrumentalist developers on the other hand are philosophically focussed not on the technology, but rather on an analysis of the needs, opinions, characteristics of the actors within the adoption site. To instrumentalist agents, the power, advantage and efficacy of the tool is of much less importance than the match between the tool and the context within which it must operate. These developers realize that there are many innovations that will not and cannot succeed within the context because of the inherent conflict between attributes of the innovation and the environment in which they must operate. The long history of educational technology that have not been adopted convinces me that an instrumentalist approach is the one most likely to lead to systematic change.

Where we have failed to date in our attempt to develop a successful dynamist culture, within the academy, is not in constraining the freedom of faculty members to set their own teaching agendas, nor is it in actively discouraging innovation and adoption. Where we fail is in developing a culture that supports a ruthless evolutionary cultural of survivalism. Effective innovations are allowed to grow, but so are the ineffective. We have no "bottom line" to easily measure our quarterly performance and we steadfastly refuse to put our best minds towards the task of developing means and measures to evaluate the impact of our innovation on teaching and learning. This is a problem for both traditional and technology enhanced instruction. David Noble (1998) asks "if students are taking courses which are just experiments, and hence of unproven pedagogical value, should students be paying full tuition for them"? I would ask with equal stridency, "if students are taking course to which no empirical evaluation in regards to teaching or learning efficacy, nor any corporate or individual effort is expanded on research, development or enhancement of pedagogy, relevance or applicability has been undertaken for the past century, should they be paying full tuition either? Our challenge is to enhance our evaluation models and plans with every project so that if we fail - we do so cheaply and quickly. If we succeed, we can document the context and actions that precipitated that success.

More With More Model

All of this is background to my concluding remarks about how technology fits into the mix. The way it does not fit seems to be the way technology is advocated on many of our campuses - I call it the "More With More Model". It generally works as follows. Early adopters, visionaries, and missionaries like myself, plead with central administrators to give us more money, more technology, more teaching release time, more professional development, more student assistants, more technicians, more 'smart classrooms' and more tools and in return we will promise to deliver more high quality and more accessible education.

The University of Alberta currently spends over $1 million a year on our 30 public computer labs on campus and is still not meeting the demand for ubiquitous student access. We have a proposal before us to increase the number of smart classrooms on campus from 20 to 70 and keep them "evergreen" at a cost of $2million per year. However, 70 smart classrooms on our campus will hardly meet the ever increasing desire of our teaching staff to use even simple tools like Powerpoint presentations. Clearly, the current funding structure and model of teaching will not sustain a strategy based upon "more with more".

Polley McClure from the University of Virginnia published a simple formula to help us connect these variables. She notes that Productivity is a product of the amount of Learning and Access to the instruction, divided by the Cost to provide this education. P =(LXA)/C. *The More with More model* addresses only the Learning and increases the Cost. But in the end P, the productivity is constant or more likely to go down, unless we can very clearly demonstrate enhanced learning outcomes due to the use of technology. I believe that we will see very significant increases in learning, but they will be slow in arriving. Further, Thomas Russel shows us with the *No Significant Difference site*, http://teleeducation.nb.ca/nosignificantdifference/ that there are no guarantees that the use of any mediated form of delivery will, by itself, increase learning. The distributed nature of much networked based learning, begins to provide a small light at the end of the tunnel. Note that in the formula access is multiplied by learning - thus the effort in enhancing technology through distribution of our programming to new audiences through distributed education and by providing time shifted alternatives for on-campus students provide a means to improve upon the "more with more" model. To achieve the goal of increasing learning opportunities while containing costs, we have to be able to change major components of our teaching programs. We need to be able to develop appropriate combinations of independent study formats, industrialized learning systems and intense personal learning communities using both face-to-face and mediated instructional environments. The correct combination considers student learning and faculty teaching needs, but also is formulated with the costs and benefits of each adaptation are calculated as precisely as possible.

Conclusion

Universities cannot and should not extradite themselves from the rich political and social history nor from the rich cultural heritage of scholarship that we carry forward through the centuries. But neither have we the right, nor the means, to freeze the evolution of our institutions of higher learning. We are called as scientists, thinkers and teachers to empirically and philosophically test our assumptions and practice against the goals so nobly enshrined in our Latin mottoes and celebrated in the eye of our students and supporters.

We need to challenge our colleagues not in the techno-Babel of machine features or attributes that are outside of their perceived need or vocabulary. Rather we must challenge our colleagues and administration in the language of scholarship - of testing hypothesis, critically evaluating claims, substantiating our hunches and debating not only the results but also the costs of our innovations. We also need to seriously examine the values and commitments that should be driving us in a relentless search for better ways to teach and learn. These are lofty goals. Goals that will ensure the survival of the academy in a form that embraces any tool that provides long term assistance in the task of creating human beings wise enough to warrant the stewardship of this planet.

Posterel (1998) celebrates the freedom, the invigoration and motivation in play. And I'll conclude with a call for celebration of the opportunity provided to us to play in the emerging field of educational technology. My time as a change agent has been marked by a few successes, a number of things that might have happened, but didn't, and a growing list of things I really do want to get at. We are challenged by the opportunity to play in this field that is redefining the university but also the lives of each of us lucky enough to be actors on this stage. We are each entrusted with the honor and responsibility of carrying forward the traditions of scholarship, inquiry, reflection and teaching into the next century.

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How Do We Enhance Education By Using Internet In Transnational Projects?
12 years of experience in European Schools Project in Denmark

Kirsten M. Anttila, M. Ed.
Senior Consultant
e-mail: kma@dlh.dk

Mogens Eriksen
Senior Consultant
e-mail: me@dlh.dk

The Research Centre for Education and ICT
The Royal Danish School of Educational Studies (RDSES)
Emdrupvej 101
2400 Copenhagen NV, Denmark
http://www.copenhagen.dlh.dk/espdk

Abstract: Which official initiatives and which efforts are made regarding the implementation of ICT, including the use of telecommunication in the Danish school system? Taking the starting-point in different pedagogical scenarios we'll describe an approach to implementing ICT – specifically teleprojects carried out since 1987 within the framework of European Schools Project. Which educational materials have been produced to meet the need for and the demands from teachers entering transnational projects? How do we at RDSES meet the challenges in the use of ICT in in-service training, whether that be ordinary or distance learning courses? How do we collaborate between the European countries? Which initiatives are taken by the EU as far as the use of ICT and telecommunication in education?

Introduction

The authors work as senior consultants at RDSES 1). RDSES, which provides further education for teachers of the Folkeskole 2) and for lecturers at colleges of education, can trace its historical roots back to 1856. The graduate studies form part and parcel of the provision of further education for teachers. Alongside their teaching, the staff at the eight faculties and several centres - of which: 'Research Centre for Education and ICT' 3) is one - carry out research. In this way an essential part of the basis of the teaching in courses and graduate studies is brought into being. An increasing number of the research projects are carried out in co-operation with researchers abroad, many supported by e.g. the Nordic Council, EU, OECD.

Which challenges and barriers do teachers meet when they want to use telecommunication?

At a 'Council of Europe' Conference in Stockholm in 1993 colleagues from different European countries addressed us and the audience by giving brief accounts of the situation concerning telecommunication in their respective countries. Anne Villems from Estonia described her view as to which problems or barriers the teachers had to overcome:
'Hi,
Here is Anne Villems from Tartu, Estonia. This term we started with our own projects. As practice has shown it's extremely difficult for teachers: - to do too many things at a time, - to start participating in an international project, - to start to use computer and communication, - to connect projects with excisting curriculum, - to integrate activities with other subjects, - to use foreign languages, etc'.
The observations made very well expresses how teachers then and today are called to respond to new pedagogical, scientific and technological developments.

In a 'Communication Document' from a conference ' School Networks and Teachers Training', Athens, September 1998 6), the participants conclude: *'The rapid evolution of new technologies in combination with the continuous societal and economic changes pose the need for on-going teachers' professionlisation and updating'*. Conclusions similar to ours.

ICT in the Education System

Action Plan for 1998-2003 - The Danish Ministry of Education 1998 5)

In 1998 the Danish Ministry of Education published the combined strategies and action plan for ICT for the period 1998-2003. The plan describes five central areas: - the pupils and ICT, - the teachers and ICT, - the subjects and ICT, - equal and flexible access to lifelong education, - and coordination of ICT-based research and education. It's emphasized that *'It is not the objective to engage in massive investments in ICT in education just for the sake of ICT. ..ICT is to improve the teaching and learning process, and the students are to attain the basic ICT qualifications, which are necessary in the society of today and of the future'.*
Furthermore it's emphasized that: *All educational institutions are to be connected electronically in order to ensure access to knowledge and cooperation across the education sector. Moreover, Danish digital teaching materials are to be developed; materials which are based on Danish pedagogical principles.*

European Schools Project 7)

European Schools Project is a network organisation which supports a community of schools worldwide to explore applications of educational telematics. The ESP aims at improvement and innovation of educational activities and its organisation. It offers educational, organisational and technical support and provides opportunities for: - electronic communication between individuals, schools and educational networks, - the design, performance and evaluation of teleprojects, - the creation and usage of information resources, - to enhance better learning and teaching.
The first teleprojects, under the name 'Schools in Network' were launched at RDSES in 1987. In 1989 the project began to co-operate with ESP, initiated in 1988 by the University of Amsterdam, NL. The activities in ESP now include + 26 countries in Europe and beyond. Annual teachers' conferences take place in the participating countries - in 1998 in Copenhagen, Denmark, in 1999 in Tartu, Estonia 11) and in 2000 in Haugesund, Norway. Although the members of ESP are connected by telematics throughout the year, the participating teachers at the conferences find these to be an important forum for discussing pedagogical and didactical issues. The personal face-to-face contacts have also proved to be an important extra and very valuable element for designing successful curriculum collaborations.

Teleprojects

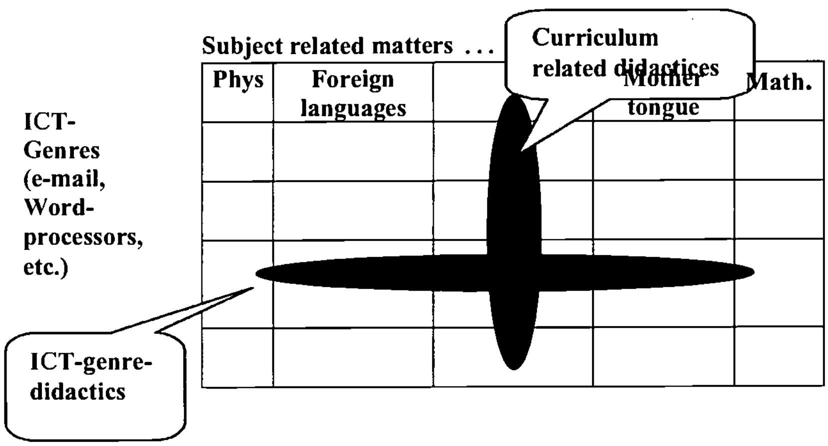
Teleprojects are co-operative distance learning projects in which telematics and foreign languages are communication tools. Teachers mutually determine a central topic of the curriculum around which students execute local (research) activities. Results are discussed and exchanged via Internet.
Materials to two of the many ESP-teleprojects, an environmental project Bionet 8) and a language teleproject The Image of the Other 9) can be found on the Internet.

The Image of the Other

'The Image' material, which is a result of collaboration between Danish and Dutch teachers, is meant for the teaching of English as a foreign (second) language for beginners (elementary stage). In this virtual classroom students and teachers experience, how they by using the foreign language and telecommunication as communication tools with their counterparts, acquire new knowledge and new understanding not only about their peers, but also about themselves, as "they are mirroring their own sitatuation in the others' ". The teachers have experienced how students improve their language skills, that the engagement in the project arise their cultural awareness as well as it is highly motivating and meaningful to take part in such a project. We thus observe a clear shift in education from teaching to learning, where the latter is strengthened and the education as such is enhanced. The Internet now thus gives all a chance - regardless of where you live - to have access to the same educational material.

Teachers' competences in ICT-genre didactics and curriculum related didactics

Teachers engaged in teleprojects all have had a traditional curriculum related didactical competence before they start. But many have lacked – at various degrees - the didactical competences related to each of the current ICT genres. It's of vital importance that a teacher before engaging in a teleproject masters both competences. Bent B. Andresen, director at the 'Research Centre for Education and ICT' at RDSES, has in the following model illustrated how the ICT-genre didactics and the subject related didactics complement each other. 10)



Teachers that acquire these ICT competences have, according to Bent B. Andresen, access to new pedagogical methods, whereas teachers who don't have these competences lack this freedom in their educational practice.

Importance of clearly formulated common objectives

Although teachers, may have access to the same material (e.g. the Image) some fail to describe the common objectives for their collaboration clearly. The emphasis could thus be put on the ICT-genres for one partner, whereas the curriculum related content was of major importance for the other. This invariably had an impact on the result of the collaboration and thereby an effect on the learning processes.

Why European in-service training courses?

ESP national co-ordinators for quite some time discussed the possibility of setting up European in-service training courses. Pedagogical, scientific and technological developments as well as the EU programme, Socrates, and similar programmes gave scope for implementing the ideas in the late nineties.
What we finally had were: - a common and far more user-friendly communication platform (i.e.www) - access to financial support from the EU, SOROS, Nordic Council of Ministers etc) to conduct in-service training courses - valuable pedagogical and organisational experience in the teleprojects as a basis for the contents of the courses - and a European team of moderators.

Co-ordination between international and national initiatives and in-service courses

The ESP co-operation and the courses running under the Socrates/ Comenius programme are most often bottom-up projects. It's vital that the courses match:
- national ICT initiatives, - national educational reforms for schools or for teacher education, - top-down European projects such as EUN (EUropean SchoolNet)

PIST

'The project makers - in-service training for educational key personnel on how to make educational projects, find partners and develop projects'.

The Norwegian and the Danish ESP-coordinators, together with a Scottish colleague ran two courses in 1997 and 1998 respectively with participants from 15 different European countries.
Experiences from these courses have resulted in a new Comenius course TRANSPRO with our Czech ESP-coordinator representing the fourth country in the collaboration. The TRANSPRO courses are planned to run in 2000.

The Nordic-Baltic Language Project

A project for teachers of foreign languages sponsored by the Nordic Council of Ministers and planned and coordinated - among others - by the Estonian, Danish, and Finnish ESP co-ordinators have run during the academic year of 1998 – 1999.
The aims of the introductory course to the transnational projects were to focus on:
- the cultural dimension in language teaching, - introduction to and designing of transnational projects based on: 'Das Bild der Anderen' (Material to be used in teleprojects in the German language) and 'The Image of the Other'- evaluation of the 15 teleprojects running during 1998-99.

Learning processes and didactics

We have learned that the following preconditions for successful in-service training in ICT should be born in mind, if you aim at running successful teleprojects: - emphasis should be placed on training processes rather than products/materials -A major priority should be the change of teachers' attitudes, since the teacher is the actual agent of innovation and change in schools, - Teacher training should be supported with the dissemination and analysis of models of 'good practice', which can be used as stimuli of discussion, reflection and change, - Teachers should be involved in evaluation of existing learning materials and this reflective/evaluative activity could form part of their training and professional development

National in-service training courses

The set up for in-service courses differ from country to country. Personally we have run an ODL course in introducing how to run teleprojects over the past 8 years with participants from both Denmark and the other Nordic countries. The Danish Ministry and others have introduced a large scale in-service training course on the use of ICT in all subjects - the so-called: 'ICT-licence' course – will be launched in the autumn of 1999.

Conclusion

Some of the observations and recommendations put forward at the Athens 6) state, what we already have experienced during the past decade or so that: *'There is obviously a trend towards 'process-oriented' pedagogy rather than 'product-oriented' or ' knowledge-centered' pedagogy.* We have to be aware that there is a shift *'from 'development of content' to 'development of practices' from text' to 'context'.... In other words, the teacher herself is called to reflect on, evaluate and participate in the development of training content and materials '6)* ICT forces us to accept a different concept of learning as well as the fact that the teacher's role is undergoing a change.
When looking upon Anne Villems's letter from 1993 we observe, that much has been accomplished during the past decade regarding teachers' pre-service and in-service training in ICT, nationally as well as internationally, but there is still a strong need for 'on-going teachers' professionlisation and updating'. As for examples of good practice much more ought to be accessable on the web. Further (action) research is needed regarding technological and educational issues also with much emphasis and stress on the evaluation of using ICT in order to ensure a high quality of the projects and thereby enhance education.

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Reshaping Academic Practices through Multi and Hypermedia

Iliana Nikolova
Department of Information Technologies,
Faculty of Mathematics and Informatics,
University of Sofia
Bulgaria
iliana@fmi.uni-sofia.bg

Abstract: This paper focuses on the influences of multimedia and hypermedia technologies on the academic practices of a higher education unit. It traces the ways in which these technologies penetrate its research, development and teaching. Multifaceted uses of Web are illustrated: as environment for course design and delivery, as research project support environment, as product integrator, as facilitator of dissemination of research outcomes and support for their implementation. Examples of on-line courses, methodology and tools for Web-based course development, and specialized educational Web sites are presented. Pros and cons of this Web-orientated approach are discussed and current problems are identified. Multimedia developments for children – an authoring tool and applications, developed by a European consortium - are also reported. Finally, reflections on the overall dimension of change are made.

Introduction

We are witnesses and active participants in a vast process of globalization of education, educational communications and professional collaboration due to the remarkable developments in the area of distributed hypermedia systems and their applications. This tendency calls for adequate changes in the traditional activities of higher education institutions to effectively integrate these innovations. Challenged by the technology rich reality, many higher education units innovate their practices – either revolutionary restructure or evolutionary enrich and re-engineer (Collis 1997) a broad range of activities. This paper focuses on the impact of multimedia and hypermedia technologies on the academic practices of the Department of Information Technologies at the Faculty of Mathematics and Informatics, University of Sofia. First the ways in which these technologies penetrate research, development and teaching are traced. Then examples of on-line courses and methodology and tools for Web-based course design and delivery are presented. Next the utilization of Web as facilitator of dissemination of research outcomes and support for their implementation is discussed. Current multimedia developments – an authoring tool for children and applications, developed by a European consortium – are also reported. Finally, pros and cons of this hypermedia-orientated approach are discussed, problems are identified, and the dimension of the overall change is estimated.

"Webbing" Research, Development and Teaching: An Overview of Adopted Web Uses

I would define "academic practices" for our Department as including *teaching, research and development* and naturally embedding *communication and collaboration* – within the staff, with students, with other professionals. *Dissemination of research outcomes and implementation of our developments* supplement our activities as well. All components of our work have been significantly influenced by the developments in the networked multimedia and hypermedia. To understand *how*, let us start from the Department's Homepage (http://www-it.fmi.uni-sofia.bg/) which is in itself a small evidence of these influences – we are citizens of the cyberspace now.
Through the sections "About us" and "Staff" the Department's profile and each of us are now accessible on-line, which *eases our contacts with colleagues and students and helps expanding our local and international collaboration.*

"Teaching" is a major section here. The Department is responsible for the informatics part of the B.Sc. program "Mathematics and Informatics", which prepares teachers in mathematics and informatics. We also run an in-service teacher training center and offer two M.Sc programs: "Information and Communication Technologies" and "Artificial Intelligence", and run informatics courses for an MBA program. Information about these programs is now available on-line, and contacts with responsible persons are directly possible. This enhances the *efficiency of our information provision and two-way communication.* One major change, which will be discussed in more details later, is *the orientation to on-line teaching.* Most of the on-line courses offered by the Department are accessible from here too.

Another dimension of change refers to the *nature* of our teaching. Since 1984, when the unit was established, we have gone through different phases where different models of instruction have dominated. Almost skipping the typical for those days in Bulgaria highly structured, teacher-centered classroom instruction (relying mostly on the teachers and textbooks as sources of information), we went through less-guided, learner-centered, exploratory style instructional environments; arriving at constructivist principles and stimulating active learning (Campbell 1998). *Today our teaching, especially in the graduate courses, is flexible and highly individualized.* It widely embeds the project approach (Nikolova & Sendova 1995) and strongly relies on the "active learner" assumption and her/his access to information and knowledge, both locally and virtually. This wouldn't have been possible without technological facilitation: availability of multimedia learning environments, Web, Intranets, Internet tools for communication and collaboration. The changes in the nature of the teaching can be summarized as: *from teacher-centered to learner-centered pedagogy, from classroom-oriented to more individualized teaching, from tool-oriented (as far as computer use is concerned) to technology mediated teaching and learning.*

The "Research" section links to homepages of a number of national and international research projects. Within them Internet is used for *disseminating information* - to announce our research to others; *for communication among partners, sharing project resources and collaborative development of project outcomes* during the lifetime of the project (e.g. MATCh [1]: homepage, Workspace, Resource bank; MALL2000); *for sharing research outcomes and products with users* (VALUE, GEOMLAND). In this way *project participation and international collaboration are greatly facilitated.*

The "Activities" section links to Web pages of conferences, workshops and seminars organized by the Department. While for earlier conferences we used to only provide information, recent conference Web site embed more interactivity and allow on-line registration (e.g. EUROLOGO99), which is *a step towards a higher level of organization and time saving for participants and organizers.*

The "Student project" area is used to expose good master's projects and to store temporarily some students' course projects - for peers to view and share. This transparency of their work *creates additional motivation.*

The "Electronic Catalogues" section contains topics-oriented collections of references to on-line resources. They have been developed for students by students and serve as a virtual extension of the student's library. In this way *peer support is facilitated.*

Discussion

Building our Web presence was an early grass-root initiative of our Department. It was later promoted at administrative level and all departments are encouraged now "to go" on the University Web site. We are aware that there is much room for improvement and enrichment of our Web site, e.g. to build more interactivity and services, to more frequently update the information. Nevertheless and despite that being on the Web is trivial today for most academic units in the developed countries, we should acknowledge that this "small" step, facilitated by the utilization of hypermedia technologies, really made a difference in our professional lives.

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[1] URLs are provided in the reference section as "on-line resources"

Teaching On-line

During the past few years there has been a definite tendency in the Department to integrate Web as a support tool in the teaching and learning process, to design Web-based courses (even for on-site students) and transfer existing courses, partly or fully, to the Web.

Why?

We went on-line for a number of reasons:
- we were challenged by some research projects, in which we participated, and gained initial experience from;
- this is an appropriate solution for our local environment, as a Web-based course provides the flexibility which our students need and we want to offer them;
- access to course resources and related international publications is easier for the students in this way (it may sound paradoxically, but it is true in our case, where new books in English hardly reach students' libraries)
- it extends the scope of our teaching geographically and in the number of students taught
- it eases the reuse of course materials
- it eases sharing courses and resources among staff

Some examples of On-line Courses

Most of the courses developed at the Department are supported by course Web sites, built around the virtual university and classroom metaphors (Nikolov & Nikolova 1996; Dicheva, Djakova & Bachvarova 1998). The site integrates course materials and links to on-line resources, possibilities for interaction between the instructor and students and among students themselves. Some course Web sites support group discussions through WWW boards, some allow on-line testing with automatic assessment. In most cases the courses are taught in a "simulated distance" mode – with some face-to-face sessions, but most of the students activities, assignments and communication are performed at student's convenience within a given period of time. The results are delivered to the instructor via e-mail or by uploading to the Web site. A few course examples are presented below.

Telematics and Distance Education

An elective graduate course from the "ICT" M.Sc. program (an early version of this course was the first experiment for teaching on-line in the Department). Developed as a self-initiative of the instructor, without any financial or administrative support. It was inspired by the course "Tele-learning" (Collis 1997) and is supported by a Web site (Fig. 1) which embeds course information and study materials, allows personal and group e-mailing and group discussion. The course is organized in units, each unit presuming self study of preparation material, face-to face session, off-class individual learning activities, and assignments submitted electronically. Feedback is provided either individually - by e-mail or face-to-face - or through a Web discussion board. All students develop course projects, individually or in groups of two. Project guidelines and support are provided through the Web site too.

Business English

Developed in the frames of a European project. The Web site (Fig. 2) is built around the virtual classroom metaphor (Stefanov, Dicheva, Nikolov & Djakova 1998): there are *walls* (for course description and syllabus), *message board* (for instructor's guidelines), *shelf* (for frequently used 'books'/sources), *corners* (for self-study activities), *gateways* (to the Post Office, Student Centre, Conference Centre, Video Centre, Library, and the Cafe). The units include pre-reading, reading and post-reading activities and interactive assignments.

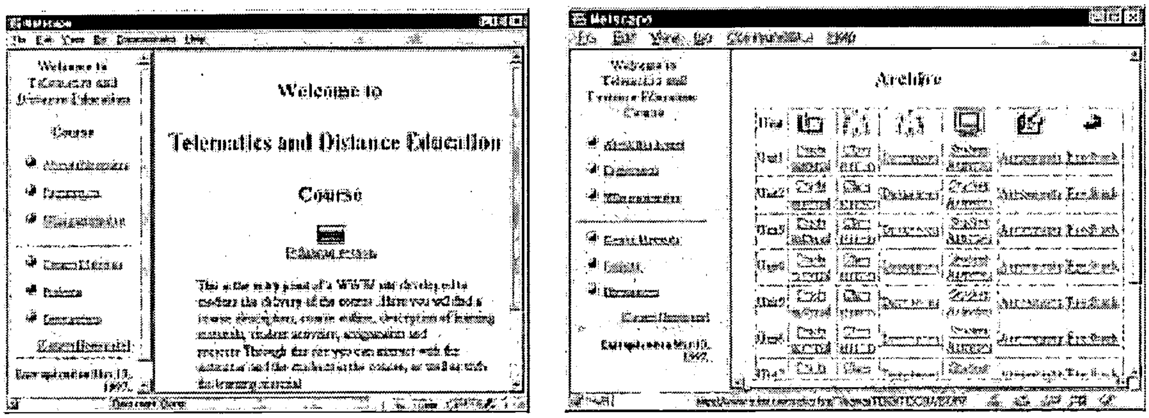

Figure 1: "Telematics and Distance Education" course

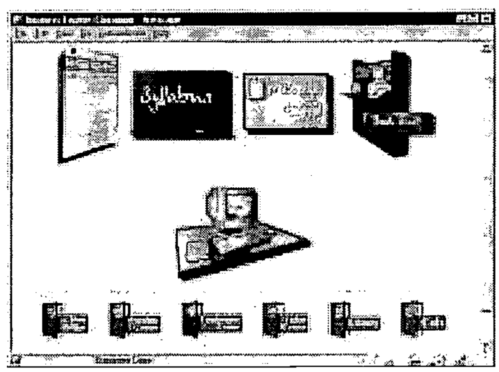

Figure 2: "Business English" course

Business on the Internet

Developed in the frames of a European project. Intended for graduate students in Economics and Business administration and clients from SME. Delivered through a virtual learning environment (Nikolov & Stefanov 1998) providing access to lectures and guest lectures, resource bank, tests and essays, group discussion.

Discussion

The experience gained so far has outlined both positive and negative aspects of Web-based teaching (Nikolova & Collis 1998; Dicheva, Djakova & Bachvarova 1998). According to students' views among the advantages are: *"flexible in space and time, which is very convenient; allows better concentration when studying on your own; allows your own pace through the course material, which enhances motivation; on-line, non-subjective testing; stimulates regular learning during the semester"*, while some drawbacks are: *"problems with speed of access and network stability - alternative ways of offering the course material, where possible, is desirable to minimize the on-line reading time; more intensive feedback from the instructor is necessary when the course is fully on-line"*.

One major specifics of the on-line courses is that they rely very much on the self-motivation and self-control of the learners, on the one hand, and appropriate technological infrastructure, on the other. Before a wider exploitation is considered, more in-depth evaluation is still needed and stronger administrative support is desired.

Methodology and Tools for Web-Based Course Design and Delivery

The Department has to deliver instruction in the field of ICT to different target groups – pre-service and in-service teachers, master students in ICT, AI and BA. The tendency to employ hypermedia technologies and the experience gained from the first Web-based courses called for a more general solution in order to offer more flexibility for the students while at the same time being more efficient in course design and development. A method for designing flexible instructional modules was developed (Nikolova 1996) to assist in designing modules, which are adaptable to different learner's needs and different delivery platforms. Later two software tools were developed to support the implementation of the method: Course Wizard - a desktop database-driven application, and Course Developer – a multi-user Web-integrated database-driven system. The method and the tools are briefly presented below.

The Method for Flexible Instructional Modules Development

The method is rooted in the theory of flexible learning (Van den Brande 1993; Collis, Vingerhoets & Moonen 1995). Flexibility is defined as offering the learner choices with respect to a number of flexibility dimensions, related to course time, content, entry requirements, instructional approaches and learning materials, delivery and logistics (Collis 1996). Telematics has an essential role to play when planning for more flexibility. For example, adding a *tele-learning* dimension to a traditional course, one can distinguish two further stages (Collis, 1996): *pedagogical enrichment* - when the components of the course and their balance are preserved, but the nature of activities changes due to the new possibilities offered by tele-learning; *pedagogical re-engineering* - when the course changes both in structure and nature of the activities.

The method is developed for an instructional provider (the Department, in our case) who, while given limited staff time and resources, has to design instruction for a range of learners' groups who share similar needs in a particular subject domain. It prescribes to construct a *generic module* which permits *adaptations* (variants for each group), the overall effort in terms of staff time and resources being less than when developing the variants separately. The method encourages team course design.

The main concepts employed by the method are: *generic module, adaptation* and *resource bank.* The *generic module* is designed for a particular subject domain and for a defined range of target groups. It is a *backbone* in terms of content, pedagogical profile and instructional materials. It is not a ready-to-use instructional module in itself, but a resource, which purpose is to facilitate the production of adaptations. An *adaptation* (Fig. 3) is a ready-to-use instructional module, which derives from the generic module and is designed for a particular target group. At certain moments more than one adaptation will exist around one generic module. The *resource bank* (Fig. 4) is a set of *resources* (stored in a database) which can be used to produce adaptations and to revise the generic module. Elements are added to the resource bank during the whole process of method application.

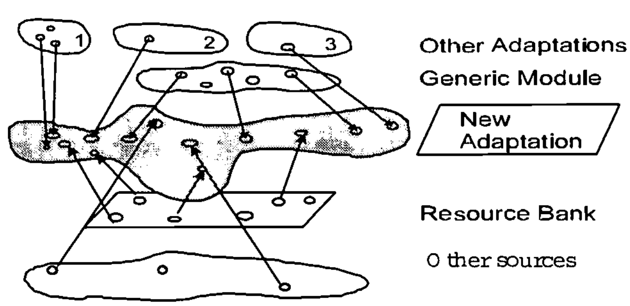

Figure 3: How an adaptation derives

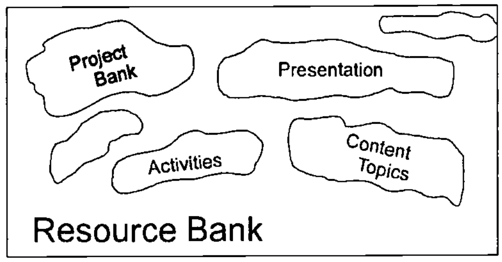

Figure 4: A Resource Bank

The Course Model

A course is a set of units. Each unit can have its own structure (Fig. 5), which is a subset of a predefined component set (default pedagogical profile). The latter includes: lecture or demonstration, communication b/n instructor and learner, group discussions, individual study and preparing exercises, individual or group project, student's testing, feedback from the instructor (Collis 1997). To each component one or more instructional materials can be assigned. The instructional materials are part of the resource bank and are stored in the course database. The database also stores information (as links) about the structure of the course and its units.

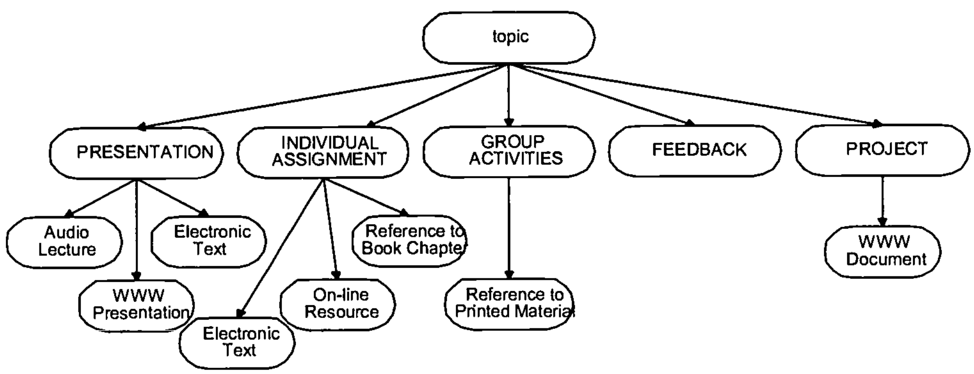

Figure 5: Sample unit structure

Course Wizard: A Desktop Program for Course Design and Course Web Site Generation

Course Wizard is a desktop application (Nikolova & Pelovski 1998), which leads the designer through the process of building a generic module and/or an adaptation. Throughout this process the course database is created - the designer provides course information, schedule and structure, assigns materials. Then the course Web site is automatically generated by using an existing template and asking the designer to specify additional information to customise the layout (Fig. 6). The Web site of the "Telematics and Distance Education" course (Fig. 1) is an illustration of the result. Course Wizard eases the multiple uses and updates of a course. The program is implemented in Borland Delphi and uses Borland Interbase Server.

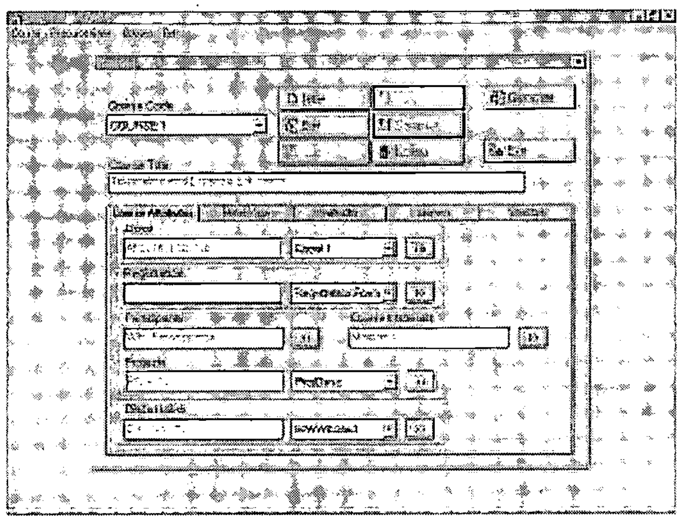

Figure 6: Course Wizard: Specifying the course homepage

Course Developer: A Web-based Course Support System

Course Developer (Nikolova, Boyanov & Dimitrov 1999) is an ancestor of Course Wizard in terms that it supports the design of courses of the above model and generates a Web site to mediate the course delivery. It has additional features and functionality though, which make it a powerful course support system. It has a Web interface (Fig. 7) and enables team development/update of a course over the network. It allows different types of users - administrator, designer, tutor, student and guest - with different access permissions. Supports not only the process of course design and development, but also course delivery by offering registration of tutors and students, access to course materials, internal course mail, discussion center and information on student progress and tutor's tasks. A module for automatic test generation and student assessment is also available. Course Developer is a Web-integrated, database-driven system, which uses dynamic pages based on the ASP technology.

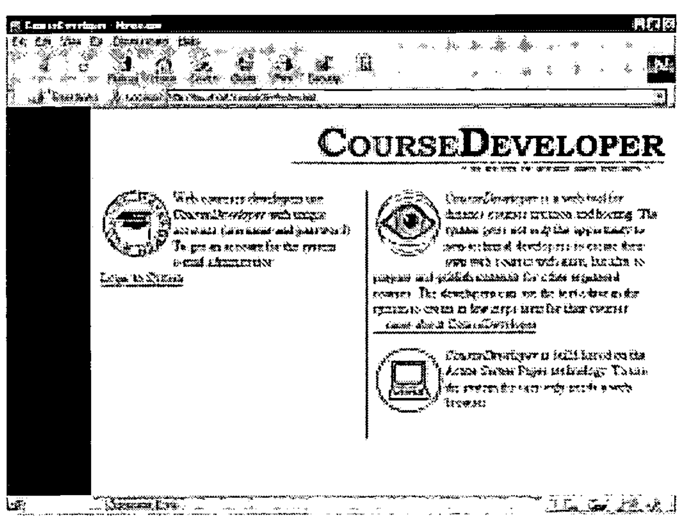

Figure 7: Course Developer's homepage

Discussion

Web-based course environments require powerful infrastructure and are expensive to produce. Many professional systems for Web-based course support exist nowadays (http://www.online.uillinois.edu/oakley/): Mallard, CyberProf, Web Course in a Box, TopClass, WebCT, Lotus Learning Space and many more. Our Course Developer system is a result of the research effort of a small group of people and was developed with almost no financial support. In this sense it can hardly compete with the above systems. The advantages are that it is tailor-made – it closely fits our needs, and the work on it allowed us to not only be users, but also engineers of such environment, which has an added value for better understanding the anatomy of the process, tools and outcomes. If we move to a large-scale on-line teaching, we will probably choose companies' products, but the experience gained will still be valuable and helpful.

Sharing Research and Development Outcomes and Providing Support to Users

A significant part of the Department's research and development outcomes is directly useful for schools and teachers, but there is neither appropriate infrastructure, nor organizational and administrative support for bringing it to them. It is quite cumbersome to manage the flow of individual and group requests coming from all over the country, organize in-service teacher training and follow-up activities, as a voluntary supplement to one's regular activities. Still we continue doing it as teachers inquire us and we feel we can help. But it is very important to be able to do it with minimum time, effort and distraction from our direct work. Some examples of employing the Web to ease the transition from research labs to potential users are presented below.

VALUE – A Virtual Almanac for Logo Users and Educators

The project "Learning by developing with Comenius Logo", initiated by the Teacher Training Center run by the Department, aims to bring the spirit of Logo and Logo educational philosophy to the Bulgarian schools (Nikolova 1997). Comenius Logo (Blaho & Kalas 1998) - an attractive and sophisticated environment with considerable conceptual and operational power - was chosen as software platform. We adapted the system to the Bulgarian language, developed Bulgarian on-line help, and a whole range of reference, teaching and learning materials (lessons, problems, projects, microworlds) for teachers and students. In this sense the project is a good example for initiating and supporting educational innovations (Fullan 1991). We used the Web as a supplementary channel for delivering our production to users, getting feedback and establishing collaboration with motivated teachers. VALUE: A Virtual Almanac for Logo Users and Educators was created (Nikolova & Ginkulova 1998). We integrated there the developed materials and embedded communication and discussion (Conference Room metaphor), event announcement (Message Board), building virtual Logo community (Guest Book metaphor). For easier orientation within the site a *site map* (Fig. 8) is available. A lot of users benefit from VALUE, which lowers significantly our load and contributes to the effectiveness of the implementation process.

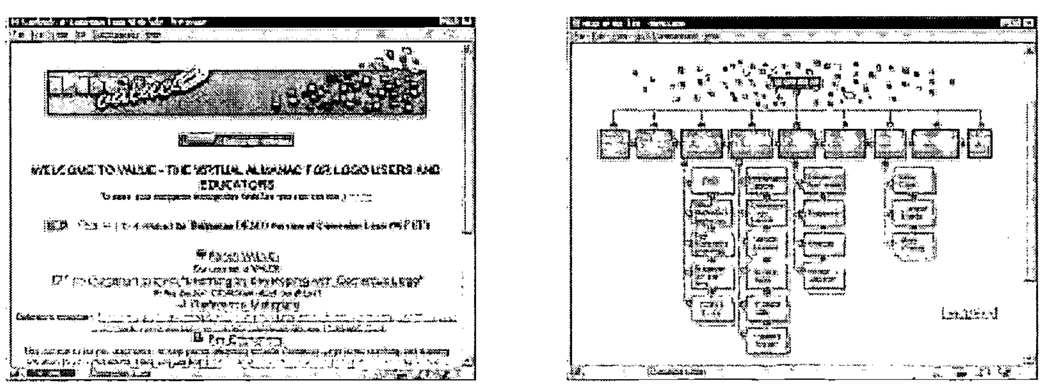

Figure 8: VALUE: Homepage and Site map

GEOMLAND – A Laboratory for Mathematics Explorations in Logo Style

GEOMLAND (Sendov & Sendova 1997) is a powerful Logo style learning environment for mathematics explorations, developed at the Department. Its dissemination and school implementation is accompanied with similar problems as the ones mentioned above. A recently developed Web site (Fig. 9) makes it convenient to provide users with what they need – the software is downloadable from there, research and methodology papers, demonstrations and examples are available. The time spent until recently on personally advising users, providing information and demonstration for them can be now allocated to other tasks.

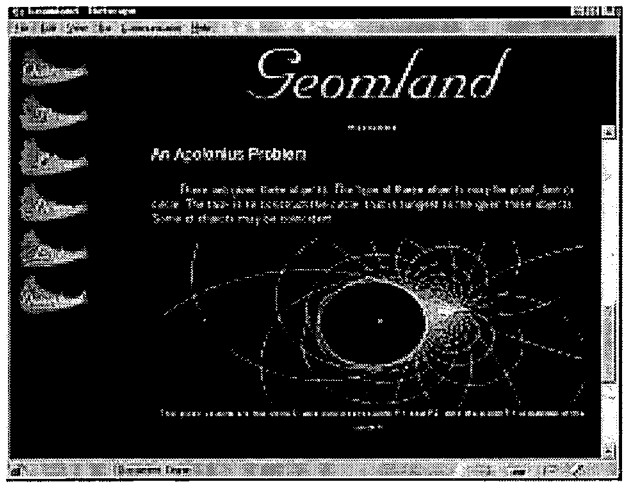

Figure 9: A GEOMLAND Web page

School Resource Bank – A Subject-Oriented Web Resource Catalog

Our students make field-oriented Web searches and develop useful collections of annotated on-line resources. One example is the School Resource Bank (Fig. 10), which is a subject-oriented educational catalog. It is included in the Department's Web site and offered also to the Bulgarian I*EARN section for use by schools with Internet access.

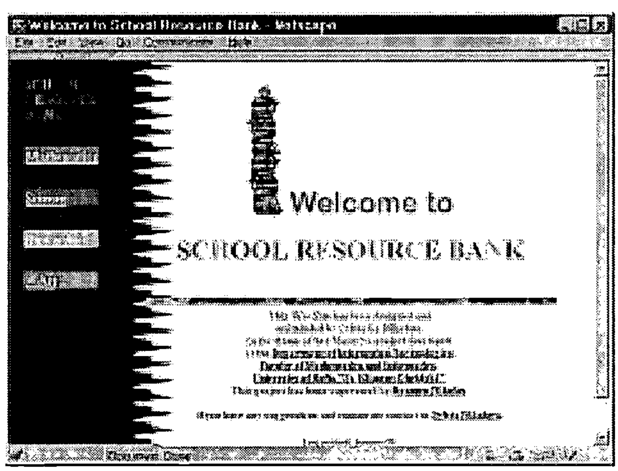

Figure 10: School Resource Bank

Discussion

Maintaining educational Web sites does not only save time and help reach more users. Feedback from users is facilitated, two-way communication channel and mutual collaboration are established. Another positive effect is, that offering meaningful material and helpful interactions to teachers in such a way, they get used to using Internet for educational resources and motivated to make their own Web developments.

MATCh: A Multimedia Authoring Tool for Children

A recent European project with partners form Slovakia, Hungary, Holland, UK, Greece and Bulgaria was devoted to developing an environment for multimedia authoring for children (Triantafilou et al 1997).

MATCh Overview

The system employs the constructivist learning philosophy and supports creative thinking and expression by means of multimedia technologies. It consists of five tools – Frame, Sound, Animation, Story and Web editors. In the Story editor the user can create applications (stories) by combining multimedia resources – either already available or self-produced by the Frame, Sound and Animation editors. The Story editor can be entered at three levels (Fig. 11): *beginner's, intermediate, advanced*, and two modes: *run* (to play a story) and *edit* (to create a story). The Web editor can export (with some restrictions) a story into a Web presentation. During the school testing the environment was well accepted by the teachers and students and proved to be an appropriate component of today's technology rich classroom. Especially the Story editor, with the ease of use and attractiveness of the final result, was valued as a motivating and rich context for active learning and creative expression. An important requirement for the effective use of the system is the availability of rich libraries of multimedia resources for the children to start.

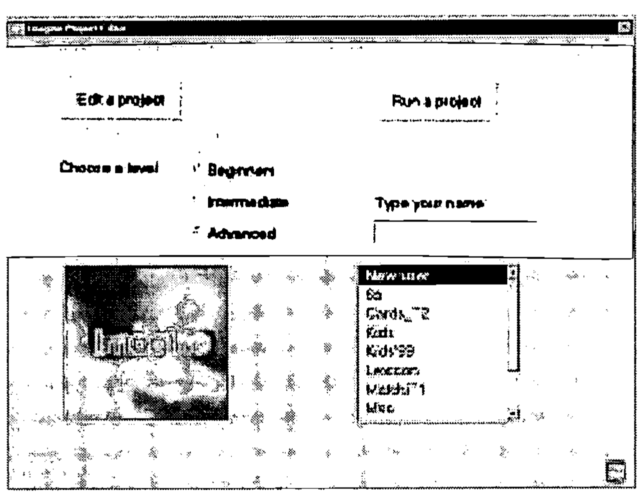

Figure 11: Story Editor: Entry Screen

Applications Developed by the Bulgarian Team

Several MATCh applications were developed to demonstrate the power of the environment and serve as system testbeds. Some of them are quite complex and have an educational value on their own.

Multimedia Screen Cards

A *multimedia screen card* is a moving, speaking, singing card, the user can play with (click on certain elements to make something happen), print, modify, export into a Web page. Each card has its own scenario, i.e. is a short multimedia story. The application faces children with most popular European traditions and festivals and with personal occasions, when people interact with each other by sending greetings, expressing good wishes or appologies. It tends to stimulate children for a more social style of behavior and interaction by using new means of expression - multimedia technologies. Sixteen sample cards for different occasions were developed (for Christmas, St. Valentine's Day, Easter, Mother's Day, Birthday, GetWell, Apology, etc.) and built into a consistent Screen Card World with a well designed visual navigation. The user is taken by hand by the main character, the Duck, who tells a story about each occasion (Fig. 12). Then the sample cards for this occasion can be played with (fig. 13). Not only can the child enjoy the Screen Cards World – its cognitive value, intriguity, variety, brightness, dynamics and interactivity. There is more: she can use the rich collection of resources developed for this application – actors, images, sounds, music, recorded speech, backgrounds – and combine them in her own way, thus designing her own cards and multimedia stories.

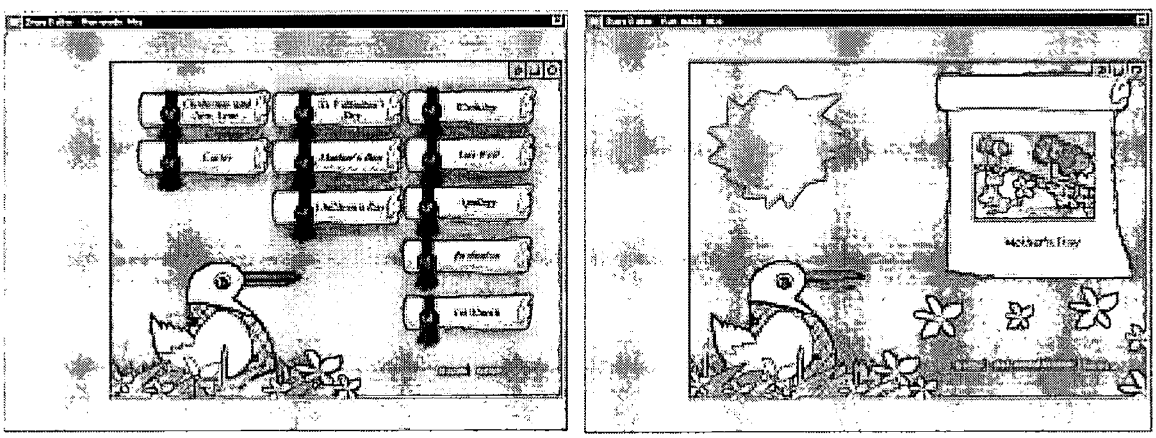

Figure 12: Multimedia Screen Cards application

Figure 13: Playing sample cards: "Apology" and "Get Well"

Save the Animals

This application illustrates the possibility to design multimedia games with Match. It is a story where the child plays the role of a Zoo Detective, trying to help an animal in danger (Fig. 14). The application has a modular structure and allows modification and extension. A rich collection of resources was developed for it: animated actors and animals, media files and backgrounds.

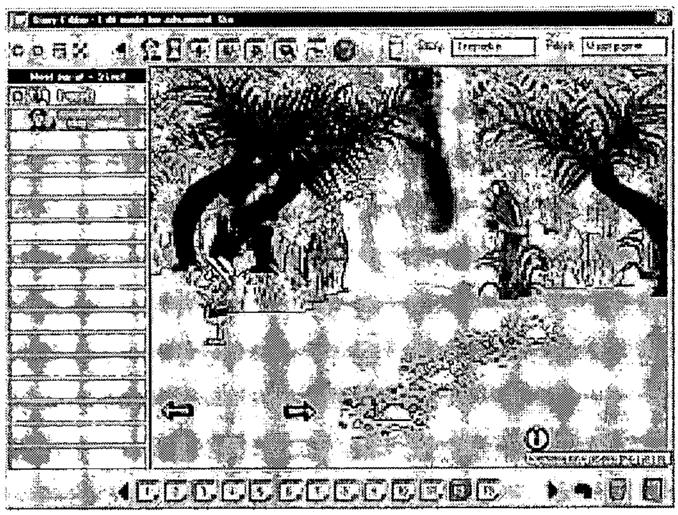

Figure 14: Save the Animals (Editing a page of the story)

Children's Projects

While testing the system and applications in school, children made their own production with MATCh – individual screen cards and class projects: "Meet our class" (Fig. 15) and "Class album". This work kept them very much involved. An interest to different types of information was provoked and children were motivated to learn more about using and processing texts, pictures, movements, sounds and music.

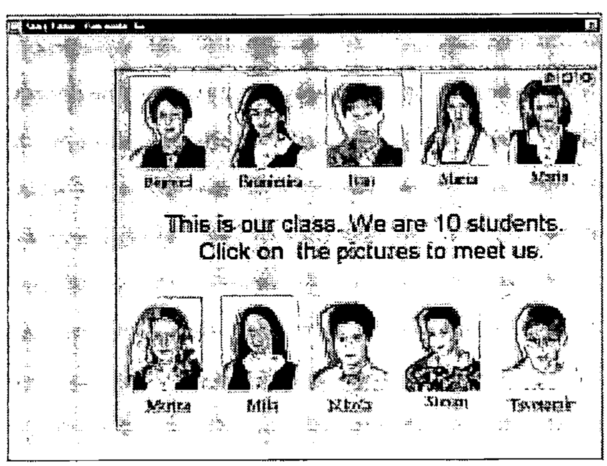

Figure 15: Meet Our Class project

Discussion

Why multimedia authoring for children? To provoke children's thinking, imagination, expression, active learning (Druin & Solomin 96). To enable children taste the process of creating multimedia and personalize the basic concepts of the multimedia world surrounding them. To create a context, in which each child can contribute to an enjoyable collaborative activity with what s/he is talented for – choosing/creating/mixing music, telling a story, creating an interesting scenario, drawing, producing animation, designing interface. There are various roles as various the children's preferences can be.

Reflections

The dimension of change illustrated by the above is not only a technological one. It is much broader, concerns attitudes and culture and refers to both professional and personal level. The overall tendency of virtualization and globalization of our professional lives is sometimes in conflict with the intuitive reaction to defend ourselves from an intra-personal Internet invasion. On the other hand, armed with the modern technologies, we were able to establish a meaningful context for challenging and rewarding professional activities within an environment, which is still suffering from social, economic and organizational deficiencies.

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Business English course (http://sparc10.fmi.uni-sofia.bg/BEC/)
Business on the Internet course (http://www-it.fmi.uni-sofia.bg/business/)
Department of Information Technologies homepage (http://www-it.fmi.uni-sofia.bg/)
EUROLOGO99: Seventh European Logo Conference (http: //iea.fmi.uni-sofia.bg/eurologo99/)
GEOMLAND (http://iea.fmi.uni-sofia.bg/PGS/)
MALL2000 project homepage: (http://www-it.fmi.uni-sofia.bg/mall2000/)
MATCh project homepage (http: //www-it.fmi.uni-sofia.bg/MATCh/)
MATCh Resource Bank (http://www-it.fmi.uni-sofia.bg/MATCh/resources.html)
MATCh Workspace (http://www-it.fmi.uni-sofia.bg/MATCh/workspace.html)
Telematics and Distance Education course (http://www-it.fmi.uni-sofia.bg/~iliana/TDO/TDO97/)
VALUE: A Virtual Almanac for Logo Users and Educators (http: //iea.fmi.uni-sofia.bg/value/)

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FULL PAPERS

Evaluation of Effective Interventions to Solve the Drop out Problem in Adult Distance Education

Yonnie Chyung
Donald Winiecki
Jo Ann Fenner
Instructional & Performance Technology
College of Engineering
Boise State University
1910 University Dr.
Boise, ID 83725
ychyung@boisestate.edu

Abstract: Described in this paper is a case study of evaluation conducted in the instructional & performance technology (IPT) department at Boise State University (BSU). The IPT department offers a distance education (DE) option in its Master's degree program. This case study describes the effective interventions that the educational organization used to reduce the drop out rate. The drop out rate during 1989 and 1996 was 44%. The IPT DE program designed and implemented interventions to reduce the drop out rate during the three semesters in 1997. Within a year, they found that significantly positive results were obtained from their interventions. The purpose of this paper is to help audience understand how to design, implement, and evaluate interventions to reduce high dropout rates. Several instructional design models and an evaluation model such as the ARCS model, the Organizational Element Model (OEM), and Kirkpatrick's evaluation model are discussed in the paper.

1. Introduction

1.1 Adult Education

The U.S. Department of Education defines adult education as the teaching of adults via any education activities, except full-time enrollment in higher education credential programs. According to the Digest Education Statistics published by the U.S. Department of Education (1997), the number of adult education participants among 117,826,000 employed persons during 1996-1997 was 59,734,000.

What motivates adults to be involved in continuous formal education? Houle (1971) conducted a qualitative study from which he identified three types of adult learners: goal-oriented participants, activity-oriented participants, and learning-oriented participants (cited in McCreary, 1990). Verduin and Clark (1991) categorized three main types of adult education programs: adult basic education (ABE) programs (to acquire ABE), leisure and enrichment education programs (to increase enrichment in adult life), and career education programs (to prepare or upgrade their job-related knowledge and skills). Examples of adult education activities include part-time college attendance, classes or seminars given by employers, classes taken for adult literacy purposes, adult basic education or English as a second language, or courses for recreation and enjoyment.

1.2 Adult Distance Education

Distance education is defined as "any formal approach to learning in which a majority of the instruction occurs while educator and learner are at a distance from one another" (Verduin & Clark, 1991, p.8). Distance education, due to its time and geographic flexibility, has appealed to working adult learners who work full-time yet want to seek for continuous education. Many adult learners attempt to achieve their goal of adult learning via distance learning options. Distance education institutions use various distant learning technologies such as audio and video conferencing devices, the Internet, or computer-mediated communication systems.

According to a survey conducted by National Center for Education Statistics in 1995, out of about 14.3 million students enrolled in higher education institutions in fall 1994, about 758,640 adult students formally enrolled in distance education courses in academic year 1994-95. Eighty one percent of institutions reported that they offered courses designed for undergraduate students; thirty four percent for graduated students; and thirteen percent for professional continuing education. Among the distance education institutions, thirty nine percent of them targeted professionals who were seeking recertification, and 49 percent targeted other workers who looked for skill-updating or retraining as potential audiences.

1.3 Adult Distance Education in Boise State University

The Instructional & Performance Technology (IPT) Department at Boise State University offers a Master's degree program via distance education (DE). The IPT-DE program is intended to prepare adult students at distance for careers in the areas of instructional design, job performance improvement, human resources, organizational redesign, training, and training management. The majority of students attend the IPT's distance program not only to earn a master's degree in IPT but also to upgrade their professional knowledge and skills. The majority of the adult distance learners who enroll in the IPT-DE program are classified as goal-oriented and learning-oriented learners. The asynchronous computer-mediated communication (CMC) environment that the IPT-DE program provides in the DE classes has been helping the adult learners engage in interactive and dynamic discussions among the participants and achieve their goals of higher education through the collaborative learning experiences.

2. A Problem in Adult Distance Education

Although distance education has appealed to working adult students who work full-time and seek for continuous education as part-time students and allow them to attempt to achieve their goal of adult learning via DE options, a problem in DE has been a high turnover in enrollment. Retention of DE students is usually lower than retention of on-campus students (Verduin & Clark, 1991). Reasons for dropouts are found to be various. Adult DE students tend to drop out of DE programs when they perceive that their interests and course structure are not matched (Fenner, 1998), that they are not confident enough in learning processes (Chacon-Duque, 1987), and/or that they have achieved what they wanted (Holmberg, 1989 cited in Verduin & Clark, 1991).

The dropout problem in DE programs was found in the IPT-DE program at Boise State University as well. Between the fall semester of 1989 and the fall semester of 1996, 44% of DE students dropped out of the IPT-DE program by their third course (Fenner, 1998).

3. Systemic and Systematic Interventions

In order to solve the dropout problem, it is important to approach to a solution in a systemic and systematical way. It is critical to conduct a careful analysis on the causes to the problem first, then to seek for the most appropriate solutions to the problem, to implement the solutions, and evaluate the effectiveness of the solutions. The ARCS model, the Organizational Element Model (OEM), and Kirkpatrick's evaluation model guide such processes.

First, according to Keller's ARCS model (Keller, 1987), there are four factors that influence the degree of learners' motivation to learn: Attention, relevance, confidence, and satisfaction. Learners lose their motivation to learn and quit learning, especially when they do not perceive the instruction as interesting or relevant to their goal. They also lose motivation to learn when they are not confident in learning processes, and/or they are not satisfied with the instructional processes. Therefore, it is critical to design DE instruction based on the ARCS model in order to prevent dropouts.

According to the OEM (Kaufman & Thiagarajan, 1987), there are four elements in a results chain: Organizational inputs, processes, products, and outputs. Effective instructional *inputs* and *processes*, possibly designed based on the ARCS model and delivered by an educational organization, will result in successful learning outcomes, which is one of the educational organization's *products*. Learners who experience successful learning outcomes will more likely continue to be motivated to learn; that is, there will be a high retention rate in enrollment, which is one of the educational organization's positive *outputs*.

In order to evaluate the effectiveness of the educational organization's inputs and processes, products, and outputs, Kirkpatrick's model of evaluating training programs can be used (Kirkpatrick, 1996). The level 1 evaluation is to measure learners' reaction to the educational organization's instructional *inputs and processes*. Since the instruction was designed based on the ARCS model, it is appropriate to evaluate learners' reaction to the instruction based on the four ARCS elements. That is, measured are learners' perceptions on their attention levels during the instruction, relevancy of the instruction to their interests, confidence levels in learning, and satisfaction levels toward the instruction as well as the instructor. The level 2 evaluation is to measure the educational organization's *product*: i.e., the learning outcomes. The level 3 evaluation is to measure the educational organization's *output*: i.e., whether the dropout rate has decreased or not. A summary of the systemic and systematic interventions and evaluations of the effectiveness of the interventions conducted by the IPT-DE program at BSU is illustrated in Figure 1.

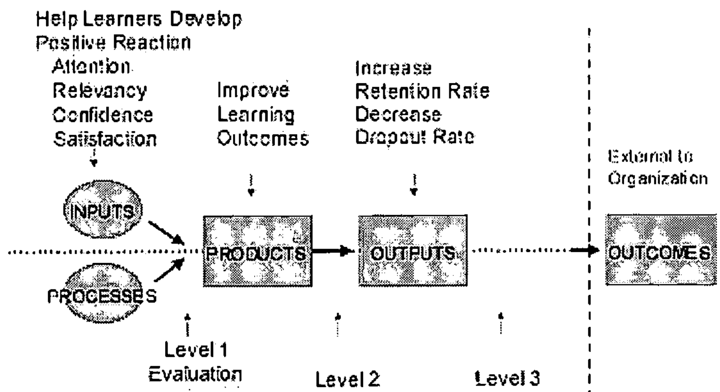

Figure 1. Systemic and Systematic Interventions and Evaluations

4. Cause Analysis

In order to find out the causes of the dropout problem, the IPT-DE associate program developer conducted interviews with the students who dropped out of the program as well as those who were continuing the program between 1989 and 1996. From the interviews, it was concluded that their satisfaction levels during the first or second courses were the major factor that determined their decisions to continue or not to continue the program. Forty two percent of the students who dropped out of the program expressed 'dissatisfaction with the learning environment' as a reason for their dropout. More specific reasons for dropouts included:

- discrepancies between their professional or personal interests and the course structure
- low confidence levels in distance learning
- doubts in successful online communication
- incompetence in using the DE software as an effective learning tool
- feelings of being overwhelmed by the advanced knowledge and overloaded information
- de-personalized learning environment.

5. Intervention Plan

From the cause analysis, it was obvious that a solution to the dropout problem must be to help new distance students be satisfied with instruction and improve their performance as well as their confidence levels during the first and second courses. During three semesters (spring, summer, and fall) in 1997, the IPT-DE program addressed how to design instruction to be more *attractive* enough to keep new DE students motivated in learning, to be more *relevant* to their professional interests, and to increase individual students' *confidence* and *satisfaction* levels toward the instruction. The ARCS model and the OEM were used to guide the instructional design and developmental processes. Especially the instructor of the first DE course aimed to help her students develop self-regulated learning skills in the DE environment. In doing so, she used various *instructional* strategies, including:

- to administrate a pre-knowledge assessment to measure students' previous knowledge levels at the first week of the semester
- to interact with individual students as much as possible and encourage them to interact with each other as well
- use all types of data presented by individual students in order to know the students better
- to break down the instruction into small weekly modules and help them master each module at a time

- to inform students of the goals and objectives of the weekly instruction and encourage them to self-evaluate their weekly learning process as well as weekly learning outcomes
- to provide students with clear criteria of expected performance levels
- to provide specific help to the students who have low pre-knowledge levels and provide more challenging work to the students with high pre-knowledge levels
- to deliver instruction via multiple media such as PowerPoint slide show, the WWW, and an electronic bulletin board when appropriate
- to provide meaningful examples and analogies to help students learn new concepts
- to modify instruction based on students' background when it is possible and appropriate in order to help them see the instruction relevant to their professional and personal interests
- to conduct formative evaluations during the semester in order to obtain information about the effectiveness of the interventions and individual students' perceptions toward instruction
- to monitor individual students' performance and provide *immediate*, *frequent*, *regular (weekly),* and *personalized* feedback
- to give positive reinforcement to students when they collaboratively work toward achieving the instructional objectives

In addition to the instructional strategies presented above, another important intervention is an *administrative* strategy - *personalized advisement throughout the program.* Prior to the registration, the DE associate program developer and the faculty members provided advisement to individual DE students, especially regarding the most appropriate sequence of courses for them to take. It is in order to prevent the DE students from taking advanced courses too early and having unnecessary experiences of failure or to help them take courses that are more relevant to their professional and personal interests.

6. Evaluation of Reaction, Learning Outcomes, and Dropout Rate

6.1. Reaction (Level 1)

At the end of each of the three semesters in 1997, a course evaluation questionnaire was administered to measure students' reaction to the quality of the course and the instructor. The response scale used was A: Outstanding, B: Very Good, C: OK, D: Improvement Needed, and E: Unsatisfactory. As coding their responses, the number one was assigned to a response to 'A'; 2 to 'B'; 3 to 'C'; 4 to 'D'; and 5 to 'E'. The data of average scores revealed that students were more satisfied with the quality of the course as well as the quality of the instructor as the implementation of interventions became matured semester after semester (see Table 1).

Semester	Attention	Relevance	Confidence	Satisfaction toward Course & Instructor
Spring, 1997	M = 1.41	M = 1.92	M = 1.83	M = 1.92 & 1.42
Summer, 1997	M = 1.17	M = 1.63	M = 1.75	M = 1.50 & 1.00
Fall, 1997	M = 1.25	M = 1.47	M = 1.56	M = 1.31 & 1.06

Table 1. Level 1 Evaluation: Attention, Relevance, Confidence, and Satisfaction Levels

6.2. Learning Outcomes (Level 2)

In each of the three semesters in 1997, a pretest and a posttest were administered to measure and compare between the pre-knowledge levels and the learning outcomes. All t-tests revealed that the posttest scores were significantly different from the pretest scores (see Table 2).

Semester	Means (Learning Outcomes)	t-test results
Spring, 1997	M (pre) = 24.58, M (post) = 36.83	t (11) = -20.61, p < .01
Summer, 1997	M (pre) = 25.59, M (post) = 34.78	t (16) = -7.64, p < .01
Fall, 1997	M (pre) = 25.38, M (post) = 34.81	t (15) = -9.25, p < .01

Table 2. Average Pretest and Posttest Scores and t-test Results

6.3. Dropout Rate (Level 3 and 4)

Between the fall semester of 1989 and the fall semester of 1996, the average dropout rate by the third course was 44%. In other words, 44% of DE students dropped out of the program by their third course. At the end of 1997, a year after the interventions were implemented, the dropout rate decreased down to 22% (Fenner, 1998). Twenty-two percentage of the dropout rate from 44% is a significant decrease.

Among those who dropped out of the program, three students dropped out after the first week of the course due to hardware and software incompatibility problems. Six students cited that they decided not to continue the program because their professional goals and the degree program did not match. Other reasons cited were a health problem and time constraint.

7. Conclusions and Educational Implications

This case study revealed how systemic and systematic ID models such as the OEM and the ARCS model, and Kirkpatrick's evaluation model guided throughout the processes of solving the dropout problem in the IPT distance education program at Boise State University. The impact was significantly positive in terms of the benefits to the educational organization itself as well as to the learners themselves. Due to the educational organization's efforts of designing and implementing effective interventions based on the OEM framework and the ARCS model, the DE students perceived the delivered instruction as more interesting and relevant to their professional and personal goals. They were confident in learning and satisfied with the distance learning environment. Due to the effective instructional inputs and processes, DE students achieved significant learning outcomes. Due to the positive reaction to the instructional inputs, learning processes, and successful learning outcomes, they more likely decided to continue to learn via distance education. As a result, the educational organization significantly decreased the previous dropout rate. It is cost-efficient to decrease dropout rates to maintain the number of enrollment, instead of trying to recruit new students. This case study revealed how effective *means* lead to desirable ends within an educational organization.

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Health Education in a Web-based Learning Environment: Learners' Perceptions

Lori Lockyer, Barry Harper, and John Patterson
Faculty of Education,
University of Wollongong
Australia
lori_lockyer@uow.edu.au
barry_harper@uow.edu.au
john_patterson@uow.edu.au

Abstract: The increasing utilization of the World Wide Web in higher education allows instructors to re examine pedagogical strategies and explore ways of taking advantage of the Web's potential to provide for learning experiences that go beyond that possible in the traditional classroom environment. Assumptions on how this enhances the learning experience for students require examination. This paper discusses a study which examines, among other issues, student perceptions of the learning experience when asynchronous, Web-based, collaborative tutorial activities are utilized within an undergraduate health education subject. Analysis of the study data demonstrates that students' perceptions of the effectiveness of the Web-based tutorials lie in their appreciation of opportunities for flexibility, reflection, and self-directed investigation within the learning environment.

Introduction

The increasing utilization of the World Wide Web in higher education allows instructors to re examine pedagogical strategies and explore ways of taking advantage of the Web's potential to provide for learning experiences that go beyond that possible in the traditional classroom environment. Our assumptions on how this enhances the learning experience for students require examination.

In an effort to investigate the use of Web-based instruction in the delivery of health education at the undergraduate level, the Faculty of Education at the University of Wollongong implemented Web-based learning activities as part of the tutorial component within its Health and Health Behaviour subject (a core subject for students enrolled in a pre-service teaching Bachelor of Physical and Health Education degree program). This study examined, among other issues, the perceptions of the learning experience for students engaging in these Web-based collaborative tutorial activities.

This paper discusses the design and development of a Web-based learning environment with embedded collaborative tutorial activities; methodology and implementation process, and preliminary findings of student perceptions of the Web-based learning experience.

Theoretical Background

Important components of the learning process are discourse and learner interaction. Duffy and Cunningham (1996) define learning as a "social, communicative, and discursive process, inexorably grounded in talk" (p. 181). Dialogue and discourse encourages the higher order thinking skills of cognitive conflict and resolution in providing context and a mechanism for explanation, justification and reason (Oliver, Omari & Herrington, 1997). Learners' interactions with instructors and other learners "give them perspective, place them within a community of learning, and contribute to their mastery of concepts and skills" (Price & Petre, 1997, p. 869).

This essential component of learner interaction and discussion in the learning process focused our attention on learner discourse through collaborative activities. The questions that guided the study included:

- How do learners participate in and contribute to collaborative health education learning activities within the class and Web environments?
- What knowledge, attitude and behaviour change occurs when students engage in collaborative health education learning activities within class and Web environments?
- What are learners' perceptions of the effectiveness of class and Web environments for health education?

Learning Environment Design and Development

Phase one of the study involved the development and formative evaluation of collaborative learning activities and a prototype Web learning environment.

For the purposes of investigating the impact of implementation of Web-based learning within the subject, six online learning activities were developed. During the first half of session, concurrent class and online tutorials focused on issues related to HIV/AIDS.

The literature suggests the pedagogical benefits of asynchronous communication includes the opportunity for learner reflection, self directed learning, and learner participation in topic negotiation and communications control (i.e., subject matter discussed, number of topics discussed, and, the speed at which communication about topics occurs) (Laurillard 1993; Romiszowski & Mason, 1996). With this in mind, Web-based learning activities were designed for asynchronous participation.

All Web-based and class-based learning activities were structured to allow for small group discussion and collaboration. The general format for the structure of each learning activity was to provide a stimulus to discussion in small groups (e.g., a survey to be answered, questions to be considered, etc.) with each group arriving at some consensus or shared understanding that could be communicated to the larger class during the subsequent lecture. In Duffy and Cunningham's (1996) terms, the learning strategy involves a problem which provides stimulus for an authentic activity where knowledge is developed through working on the problem.

Once the learning activities were designed, the Web learning environment was designed and developed. A guiding factor in the design of the Web-based learning environment was consideration of the computer and Web experience of the students enrolled in the subject. Based on history with similar cohorts, it was expected that there would be a range of computer experience among the students with the majority having little experience with computers. Additionally, it was expected that there would be a range of Web use experience with the majority of the students having either none or little experience in using the Web. Brown and Thompson (1997) argue that "interface design must provide ease of navigation, a sense of human interaction, helpfulness and responsiveness to the needs of learners studying in an information rich, self-directed medium." (p. 78) As such, particular attention was paid to constructing a Web environment with a simple structure with embedded communication tools that were easy to use.

The Web site structure included four main components: (1) the subject outline which provided information such as the rationale, objectives, content, presentation, assessment, and participation expectations for the subject; (2) the subject schedule which provided, in table format, the week-by-week timetable of lecture topics and tutorial activities; (3) resources and Web links which included links to a number of Australian and international Web sites related to the topics covered in the subject; and, most importantly, (4) the Activity Centre which facilitated the learning activities for the students who were participating in Web-based tutorials.

The Activity Centre was designed using a structure based on the suggestion that Web-based learning environments should put minimal cognitive load on the student and that templates be utilized in screen design which "promotes understanding by allowing the reader to focus on new information rather than devoting time and energy to variations of format" (El-Tigi and Maribe Branch, 1997, p.25).

The initial structure of each activity consisted of two or three Web pages. The Things To Do page outlined the activity and provided stimulus to the group discussion. Examples of discussion stimuli utilized in the learning activities included: a questionnaire (e.g., In what situations can HIV be transmitted?) to be answered and discussed by the group and a narrative that provided an example for groups to develop their own story (e.g., for risk factors of HIV/AIDS). In cases where an online questionnaire provided stimuli to the collaborative learning activity, results of the individual group members were provided on a separate, Results, page. This facilitated the sharing of ideas among group members and provided a basis for their discussion. The Discussion Area for each activity was designed to be the focal learning area. The comments submitted to this page were viewable only by group members and were displayed in chronological order on the page.

Formative Evaluation

The formative evaluation of the learning environment, with embedded activities, involved a multi-faceted approach including: review by experts in the areas of health education and instructional technology; review by instructional technology postgraduate students; and testing by undergraduate teacher trainees.

After using the Web site, the health education and instructional technology experts were interviewed and instructional technology postgraduate students were surveyed regarding: Web environment interface issues; clarity and quality of information and external links; and, perceived pedagogical effectiveness of the learning activities. Undergraduate students were asked to fill out a one-page survey of questions regarding Web site interface issues and usability.

The Web learning environment was revised, based on analysis of the data collected during the formative evaluation, with the majority of changes to the Web site focused on the individual learning activities within the Activity Centre. Specific reviewer suggestions to describe learning activities and tasks in more detail resulted in a clarification of the structure of each learning activity and thus, a proliferation of pages for each activity.

In the revised version of the learning environment, each learning activity was associated with five main areas. The This Week's Task Into page introduced the student to the activity, related the activity to the specific lecture, provided additional conceptual information and stimulus into the group activity by asking the student to respond to some initial, topical questions. Once the student submitted their response to these initial questions, they were automatically moved to the Group Tasks page. Here, the student could read a detailed description of the group task for that particular learning activity. The student also had the opportunity to view their responses and the responses of the other members in their group to the initial, topical questions by accessing the Individual Responses page. The earlier version of the Discussion Area was maintained, however, based on reviewers suggestions, an abbreviated list of the group tasks was added to the top of the page. A Submit Page form was also added, to the structure of each activity, as the area in which the group submitted their final product. All five areas of the individual activities were available to the student at all times (i.e., students are not forced to follow a particular page sequence when engaging in the activity).

Study Methodology and Implementation Process

The study was implemented in July 1998 within the Health and Health Behaviour subject. Sixty-two students were enrolled in the subject with the majority of students (57) registered in their first year of the Faculty's Bachelor of Education in Physical and Health Education degree program. The subject was conducted over a 14 week schedule.

During implementation of the study, a crossover factorial design was utilized where students were randomly assigned into two tutorial groups and each group then randomly assigned to one of two learning environments (class or Web) for the first half of session. In the second half of session, groups crossed over to engage in their tutorials within the alternate learning environment. Both tutorial groups were further, randomly, divided into working groups (seven working groups in each of the two tutorial groups) consisting of four or five students.

All tutorial sessions (conducted either in the class or in the Web-based environment) were associated with an assessable activity task for which each working group was required to submit a final group product prior to the next lecture.

During the first week of session, students were advised of the subject Web site and its location (http://www.immll.uow.edu.au/UG/EDUP144/). At that point, all students could access the subject information and resources but could not access the Activity Centre where Web-based tutorials were located.

The first Web-based tutorials were implemented in the fourth week of session while the second set of

Web-based tutorials were implemented in the eleventh week of session. This time frame allowed students to develop a working relationship with their tutorial work group; become accustomed to the process of completing and submitting their group work within the weekly time frame; and, complete three weeks of Web skilling exercises within a Information Technology subject. During the week prior to commencing Web-based tutorials, students were provided with a brief presentation as an introduction to the Web site and the structure of the learning activities. At this time, students were also given an individual username and password to access the Activity Centre.

Pre-tests and post-tests for knowledge, attitude, and behaviour related to the health topics covered by the learning activities (HIV/AIDS and nutrition), and computer literacy and computer comfort, as well as a post-test which included items related to perception of the learning environments were administered to students. The collaborative learning activities were recorded (via audio tape and electronic Web logs).

Once learning activities were complete, a representative of each working group was chosen, at random, and asked to engage in an in-depth interview regarding their experience and perceptions of the class and Web learning environments. Specifically, the interview sessions gathered information from the students regarding: how their group process was managed during weeks when tutorials were held in the classroom and when they were conducted within the Web-learning environment; their perceptions of engaging in group-based tutorials within the Web learning environment in general and the individual learning activities specifically; their perceptions of the effectiveness of the Web-based tutorials compared to class-based tutorials in terms of their own learning; and, their experience in terms of group interaction in both the Web and classroom environments.

Findings

An analysis of the in-depth interviews conducted with students who engaged in the Web-based learning environment during the first half of session (seven students representing each of seven tutorial working groups) is presented as preliminary findings.

All students expressed positive opinions on their experience of engaging in the Web-based tutorials. While one student had previously experienced a subject which was supported with Web-based learning materials, none of the students had previously engaged in collaborative group learning activities using the Web. They felt it was a "novelty"; a "...buzz to sit down and talk to three other people in different places"; and that "... it intrigued you because it was new and because it was different." All the students mentioned the benefit of the "convenience" and "flexibility" of engaging in the Web-based tutorials.

Most students (six of seven) felt that the Web-based tutorials were more effective in terms of facilitating their own learning than the classroom-based tutorials. Some suggested that this was due to the fact that, in the Web environment, they had time to research the information (either in texts or via external Web sites) and reflect on the group task. One student's explanation of the experience is indicative of that expressed by many of her peers, "... when you're all rushed, you won't concentrate . But ,when you've got time for it, you can sit down, think about it . A couple of times I'd go off and read some books that I had at home to help me a bit and make me think more about the answer. Then I could come back to it whereas, when you are in the class you've got to know straight away, right there. I mean, I'd go onto the Internet and try to find some information to give me some ideas and then I'd go back on and write my answers... so I thought that was good."

Each student was asked to comment on and compare the participation and interaction among their work group members in both the class-based and the Web-based tutorials. Only two students reported that, during class-based weeks, their group actually worked on the entire task as a whole group. The other five students reported that their group tended to separate the task into small parts and assign those parts to individuals. Then, one member of the group would be responsible for pulling together the individual parts into a final product.

This did not seem to be the case for the weeks in which the tutorials were conducted in the Web-based environment. All students noted that, during these weeks, all group members contributed by completing the individual introduction page and interacting within the Discussion Area on all aspects of the task. To complete the group Submit Page, three of the seven students noted that their group met around one computer and completed the page together. The other four students noted that their group delegated the responsibility of synthesizing the group discussion to one group member.

In comparing the nature of the interactions that took place in the two environments, most students (five out of seven) felt that more detailed contributions were made within the Web-based environment. One student noted that, "I think it makes you express what you think more because you're not talking. When we would meet to talk... one person would say what they think then the others would just say, 'yeah, I agree'." Another student felt this detailed contribution in the Web-based tutorials was due do the fact that the Web takes away the pressure of the face-to-face environment, "Some people would be sort of afraid to come out and say things. But on the Web, people aren't directly looking at you and you're not the focus of attention. On the Web, in great detail, you can tell someone about something. But in the classroom you don't tend to go into a lot of detail... I think for people who are reluctant to let everything out in the classroom, [the Web] is a really good opportunity, you don't have any pressure on you."

This student went on to explain that she noticed a difference in her own contribution, "I think I contributed a lot more on the Web than I do in the classroom, I tend to sit back and listen and just throw something in every now and then... In the classroom, if you've got very talkative people in your group, chances that you'll sit back and let them run the show. But when you're on the Web you're free to make a huge contribution if you want to, so you write as much as you want ... you say a lot more on the Web than you would in the class."

When asked what, if anything, the classroom tutorials provide that was unavailable in the asynchronous Web-based environment, some students mentioned the ability to ask questions of the tutor or another student "there and then".

The students were asked to think about their own skills in using computers and the Web and the appropriateness of the introduction to the Web-based environment which they had received. Four of the seven students interviewed said that they felt competent about using computers and the Web prior to engaging in the Web tutorials. These students noted that the brief introduction to the Web site was enough to get them started on the Web-based tutorials. They all felt that the structure of the Web-based tutorials was very easy to understand.
The other three students who were novice computer and Web users also felt that the structure of the Web environment was very easy to understand and that they were adequately equipped by the prior Web skilling exercises in the Information Technology subject to be able to engage in their Web-based tutorials. These students felt that the experience of engaging in the Web-based tutorials not only increased their computer and Web skills, but also allowed them to feel more "relaxed" using the technology. One of the students expressed her feelings in this way, "I was a bit nervous, I mean, I know computers are going to be important so I've wanted to do it, but I haven't had the confidence... actually using them for something constructive, I've got the confidence now... a big positive."

Students commented that felt they would benefit from suggestions on how to better manage the group process when engaging in Web-based, asynchronous tutorials. Some students mentioned instances when they were unsure when their work group members would be logging on to the Web site or how the final group product was going to be organized. However, it is interesting to note that many students also reported that they experienced similar process issues in the class-based tutorials.

Discussion

Analysis of this sample of data demonstrated a degree of perceived effectiveness for the implementation of the Web-based collaborative learning activities within an undergraduate health education subject.

The majority of students perceived Web-based tutorials to be more effective for learning than class-based tutorials. They suggested that contributing factors to their learning process in the asynchronous Web-based environment was the opportunity to research information using print and electronic resources and reflect on their ideas and the contributions of their work group peers. This supported the literature (Laurillard 1993; Romiszowski & Mason, 1996) on the pedagogical benefits of learner reflection and self-direction afforded by asynchronous learning environments .

The students' perceived that the quantity and quality of participation and interaction among their work group was higher in the Web-based environment. This reinforced the literature on computer-mediated communications (CMC) which suggests that collaborations within this environment can be more powerful than face-to-face encounters (Romiszowski & Mason, 1996).

Full quantitative and qualitative measurement of the effectiveness of the of the Web-based tutorials in terms of learning will be substantiated with comparisons of the pre and post knowledge, attitude and behaviour tests and with in-depth content and discourse analysis of the recorded learner interactions in both class and Web environments.

Final analysis of the data from the study are expected to provide a fuller understanding of: effective Web-based teaching and learning strategies for health education at the tertiary level; the efficacy of the World Wide Web in delivering health education; how discourse-based knowledge construction and attitude development is supported in a Web-based learning environment; and, design issues for Web-based learning environments.

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Computer-Supported Cooperative Learning Environments: A Framework for Analysis

COPPE/Sistemas
Federal University of Rio de Janeiro
Rio de Janeiro -Brazil
flavia@cos.ufrj.br

Marcos R. S. Borges
Institute of Mathematics
Federal University of Rio de Janeiro
Rio de Janeiro - Brazil
mborges@nce.ufrj.br

Neide Santos
Computing Department
State University of Rio de Janeiro
Rio de Janeiro - Brazil
neide@les.inf.puc-rio.br

Abstract: Computer-Supported Cooperative Learning (CSCL) is a research area that studies how technology can support the learning processes promoted through collaborative efforts among students working in a given task. The objective of this work is to trace a profile with the main issues related to CSCL environments. For this, a framework is proposed to organize these issues, and a report is made, including available environments and their classification in agreement with the framework.

1. Introduction

Cooperative learning is a technique with which students are supported in learning process, working together with other students and the teacher. Cooperative learning should be based on: (1) individual responsibility for the information gathered; (2) positive interdependence, so that the students feel that nobody will be well succeeded , unless everybody is; (3) better form of understanding a given material; (4) development of interpersonal skills, which will be necessary in future life; (5) development of skills to analyze the dynamics of a group and to work about problems; (6) a way to increase involvement of students in proposed activities; and (7) an interesting and entertaining focus.

Computer-supported cooperative learning (CSCL) aims to effort the learning process, using systems that implement a cooperation environment playing an active role in analysis and control of it. The collaborative technologies allow production of shared knowledge and new community practices. Several subjects of educational and technological order, related to each other, are involved in the construction and implementation of such environments. For example, to determine the kind of communication technology to be used in an environment will depend on the educational objectives pointed by the learning theory adopted by it. So, the set of features of an environment will establish its application and effectiveness.

In this context, a framework for CSCL environments' analysis appears as important conceptual maps, supplying guidelines for research and development. However, available frameworks are incomplete and do not consider important dimensions of this kind of environment. The present work gathers the main aspects of CSCL environments and proposes a framework for its classification.

2. Issues Related to Computer-Supported Cooperative Learning

In this section, we discuss the most important issues that should be observed in CSCL environments.

✓ **Learning Theories** - One of the most important factors that regulates the collaboration is the learning theory on which the cooperative interaction will be based. The learning theories aim to recognize the dynamics involved in the acts of teaching and learning, and try to explain the relationship between the pre-existent knowledge and the new knowledge. Learning is not supposed to be just intelligence and knowledge construction, but basically personal identification and relationship through the interaction with other people. CSCL environments should provide both dimensions and bring other pertinent factors in the human mediation through the technology. Several theories contribute to the understanding of cooperative learning. These theories have in common the assumption that individuals are active agents in the search and knowledge construction within a significant context. In Table 1, the main characteristics of learning theories related to cooperation, are summarized.

Learning Theories	Characteristics
Genetic Epistemology of Piaget	Central point: cognitive structures of the individual. Development facilitated by the offer of challenges. Social interaction and interchanges among individuals stimulate the process of knowledge acquisition.
Constructivist Theory of Bruner	Leaner is active in the process of knowledge acquisition. Determination of more effective sequences of material presentation. Contemporary theory: to create closer learning communities of collaborative practice in the real world. (Kearsley, 1998)
Partner-cultural Theory of Vygotsky	Cognitive development is limited to a certain potential for each range of ages (Proximal Zone of Development). Complete cognitive development requests social interaction.
Problem Based Learning/ Anchored Instruction	Learning begins with a problem to be solved (anchor or focus). Centered in the apprentice and the context.
Distributed Cognition	Interaction among individuals, environment and cultural engines. Reciprocal Teaching. Important role of the technology.
Theory of the Cognitive Flexibility	Knowledge restructuring as answer to context demands. Re-visitations to the instructional material. (Spiro at al., 1992) Activities should contain multiple representations of the content. Sources of interconnected and distributed knowledge.
Situated Cognition	Learning happens in function of the activity, context and culture of the social environment in which is inserted. Social interaction and collaboration are critical components for learning (community of practice). (Lave, 1988)
Self regulated Learning / Metacognition	Control and monitor of the own cognition by the individual. Self-observation, self-judgment, self-reaction.

Table 1: Learning Theories

✓**Models of Cooperation or Kinds of Tasks for Cooperative Learning** - The computational support in learning process can be used to treat the cooperation in different kinds of tasks. These tasks are one of the factors that will determine the cooperation model proposed by the Environment, and they can be enumerated independently of the subject domain that is being taught. Kumar identifies three kinds of cooperative tasks: concepts learning, problems solving and projects' development (Kumar, 1996). Besides these kinds, an environment can be based on Forums of Discussions, where the subjects refer to the participants' behavior, such as, "When do the students read notes?", "When do they write notes?", "What is the participation level in the class?".

✓**Domains** - Cooperative learning is generally more effective in domains where people are engaged in skills' acquisition, categorization, group planning and tasks that request construction of collective memory (Kumar, 1996). Studies proposing cooperative learning to help students to understand complex subjects in specific domain's environments (e.g., scientific thought) present good results. In procedural tasks that do not involve deep understanding, becomes more difficult to observe the occurrence of conceptual changes, suggesting that there are "more" and "minus" shared domains.

✓**Technologies** - Two kinds of technologies can be used in cooperative learning environment: asynchronous and synchronous communication. The use of one or other or of their combination will determine the interaction degree. The need of different communication possibilities will depend on the model proposed by the environment.

Interaction degrees can be small (there is a low degree of interaction among involved participants. For example, interaction happens only in the information sharing activities); medium (the interaction degree is a bit bigger, but it is already far from the effects of face-to-face interactions. For example: interaction happens when people use e-mail for communication); and big (involved people need to know more deeply the other participants and with this purpose they do social changes. For example, interaction happens when people use synchronous video-conferencing).

✓**Activities of Cooperative Work** - Depending on the learning environment proposal, it can support a wide range of activities, such as: coordination of activities; negotiation and decision making; representation of group knowledge; sharing of a database (group memory); perception of the presence and the other participants' actions (awareness).

✓**Role Assignment** - Some systems explicitly assign different roles for the users, which will have distinct rights and specific tasks to carry on in the learning process. For example, teacher/tutor role and student/learner role.

✓**Implementation/Platform** - The platform and resources used in a system development define for example, its type of users.

3. Framework for Study of CSCL Environments

Starting from the discussed issues, a framework is proposed for the study and classification of CSCL environments.

Issues	Possibilities
Theory of Learning	Genetic Epistemology of Piaget Constructivist Theory of Bruner Partner-cultural Theory of Vygotsky Problem Based Learning/Anchored Instruction Distributed Cognition Theory of the Cognitive Flexibility Situated Cognition Self-regulated Learning / Metacognition
Model of Cooperation or Kind of Task	concepts learning problem solution project development knowledge construction forum of discussions
Domain	development of the scientific critical thought ecological models scientific texts non specific domain
Kind of Interaction	asynchronous synchronous
Quality or Degree of Interaction	small medium big
Activities of Cooperative Work	coordination of activities negotiation and decision making knowledge representation group memory awareness
Role Assignment	teacher/instructor student/learner
Implementation/Platforms	UNIX Windows NT Macintosh WWW

Table 2: Framework for Study of CSCL Environments

4. Computer-Supported Cooperative Learning Environments: Brief State-of-the-Art

A study of available Computer-Supported Cooperative Learning Environments took place, aiming to classify them according to the proposed framework.

4.1. N.I.C.E.: Narrative, Immersive, Constructionist/Collaborative Environments

NICE's objective is the construction of virtual learning environments for children, based on narrative theories, construcionism and collaboration. The system was projected to be executed in CAVE, which is a virtual reality environment, room-sized where several people can move freely, both physic and virtually (Roussos at al., 1997). A theoretical framework that combines ideas of the constructivist learning theory, narrative techniques and collaboration provides the basis for it. Considering the theory of Piaget and in the ideas of Dewey, the constructivism is related to the ways that students acquire knowledge by participating in activities or tasks where they are stimulated to build, to manipulate, and to explore objects.

In N.I.C.E., it is possible to accomplish virtual construction blocks which contain characteristics that physical toys or learning tools do not have: the children can catch heavy or big objects, transfer them to another children remotely located, combine them in new objects, or simply observe modifications in their attributes as time goes by. All objects and representations are VRML models, that can be moved, increased or decreased by the children in real time.

One of the construction activity products in NICE is the narrative: both the composed stories and those created by the children who participated in an interaction with the system (Roussos at al., 1997). All the actions that took place within the environment are added to a continually composed story, even when they do not represent children's interactions. The sequence of the story goes through a parser, that changes some words for their iconic representations and publishes it in a WWW page. The collaboration in NICE is emphasized by the interaction of virtual communities (students geographically separated) and physic ones (students in the same physical space), and it could involve verbalization, collective decisions, conflicts resolution, reciprocal teaching (all facilitated by virtual reality techniques). NICE's main objectives are learning from multiple perspectives; learning how to collaborate with other people; learning by controlling and exploring active variables of the environment; programming for demonstration; exploration of structures of stories; and creation of a final product.

4.2. CSILE: Computer-Supported Intentional Learning Environments

CSILE is a collective database that supports students' ideas in textual or graphic format, available for all the participants. In this multimedia set, the students generate nodes with ideas, or part of important information to a topic in study. The data are indexed and organized in such a way that can be accessed through a series of channels, allowing students that are studying a topic in a certain domain, to access information related to it but presented in another domain. The students produce information, formulate subjects, provide feedback and evaluation, and organize the knowledge in the database. According to Gay (1996), CSILE is based on three research lines: intentional learning (attempt to actively reach an objective, different from simply try to do school activities); specialization process (process of progressive problems solution, moving besides the current competence limits); and restructuring of Schools as communities of knowledge construction. The emphasis of CSILE is in the cooperative learning, in spite of the teacher's responsibility for this experience. The teacher and all the students can monitor the learning of the other ones, answer the ideas of the other ones, request information, and make comments.

4.3. CLARE: Collaborative Learning And Research Environment

CLARE is a distributed learning environment supported by computer, where the objective is to facilitate learning through the collaborative knowledge construction. For this, CLARE provides a semi-formal representation language called RESRA and an explicit process model called SECAI (Wan and Johnson, 1994). RESRA (Representational Schema of Research Artifacts) is a semi-structured knowledge representation language specifically projected to facilitate collaborative learning of scientific texts. Wan and Johnson (1994) describes the three premises in which RESRA language is based: (1)the human knowledge can be represented in terms of a small number of primitive nodes and links; (2)the use of these primitives to characterize scientific artifact and subsequent activities in group is significant to learning process, because the learners should make themselves many deep level questions (such as, what hypothesis is being made?, With regard to what problem?, Is this theme a hypothesis or a theory?); and (3)different learners should generate different representations based on the same artifact, and comparing these representations, the similarities and differences in these points of view can be discerned. A map of the knowledge structure reflecting students mental model about the author's of the text intention will be build. SECAI (Summarization, Evaluation, Comparison, Argumentation, and Integration) defines an explicit model for a collaborative scientific texts learning process (Wan and Johnson, 1994). Metaphorically, collaborative learning with SECAI "pulls" the learners from the external, isolated and individual position to the intern perspective, integrated and collaborative in an artifact. As the learners go by the proposed activities in the SECAI model, the level of collaboration grows and at the same time a knowledge base is formed.

4.4. CaMILE: Collaborative and Multimedia Interactive Learning Environment

CaMILE supports asynchronous collaboration on then Web with the objective of fostering learning. It is situated in the CSCL approach described by Guzdial (1997) - analysis in a high level of aggregation: forums of discussions with multiple groups or a whole class. All the accesses to the system are accomplished through a Web browser that accesses a single server. System interface is based on forms, and it is the same for all the users.
The discussions in CaMILE are contextualized as in a newsgroup, even so, the context is persistent, and it is always available for the users, not "disappearing" after the visualization. Similar to CSILE, CaMILE provides a facility in which the students are requested to identify the kind of collaboration they are presenting (e.g., a subject, a new idea, a refutation, etc.) and productive initial sentences are suggested to be used in each one of these kinds of notes. The notes in CaMILE can contain everything that a Web page can contain. In agreement with Guzdial, an important difference between newsgroups and CaMILE is that this environment supports anchored collaboration, which means that each individual note can only be referenced through a Web browser (Guzdial, 1997). So, the notes direct addresses allow that Web pages contain hyperlinks for a discussion context CaMILE. The anchors function as indexes and remainders of what students discussed on a certain context.

4.5. Belvedere

Belvedere helps learners in critical discussion of scientific theories, based on the collaborative paradigm. It can be summarized as a groupware for the construction of logical and rhetorical relationships' representations in a debate, using an interface that looks like a graphic editor. Belvedere provides the students with concrete forms of representing abstract components and relationships between theories and arguments. Ideas and relationships are represented as objects that can be pointed, tied up to other objects and discussed. Belvedere can be used by students that are physically close to each other working simultaneously (synchronous); students sharing arguments in different times (asynchronous); and students working simultaneously, but remotely located to each other. According to Suthers (1996), the environment combines three approaches for learning: collaborative learning, guided learning, and problem based learning. Each one of these aspects is covered by a category of educational software within the environment: groupware for learning; intelligent tutor; and simulation. The software provides argument diagrams that dispose different geometric forms for different kinds of arguments and their components, with positive and negative links, multiple forms of connections, and possibilities of attaches to accommodate complex arguments. Belvedere also provides means for authoring knowledge on-line. This work can be accessed and copied by all the students. The environment was extended to serve as a WWW browser, allowing authors to use existent HTML tools.

5. Classification of the Environments

The analyzed environments were classified in agreement with the proposed framework.

Issues Environments	NICE	CSILE	CLARE	CaMILE	Belvedere
Theory of Learning	Constructivism Theory of Piaget	Constructivism	Constructivism	It is not explicit in references.	Problem Based Learning
Model of Cooperation or Kind of Tasks	Project development Knowledge Construction through	Knowledge construction	Knowledge construction through SECAI	Forum of discussions	Knowledge construction. Problem solving

	narrative of stories		model		Concepts learning
Domain	Ecological Model	Not specific	Scientific texts	Not specific	Discussion of scientific theories
Kinds of Interaction	Synchronous and Asynchronous	Asynchronous	Synchronous and Asynchronous	Asynchronous	Synchronous and Asynchronous
Quality/Degree of Interaction	Big	Medium	Big	Small	Big
Activities of Cooperative Work	Decisions Making Representation of knowledge Group memory Awareness	Representation of knowledge Group memory	Representation of knowledge Group memory	Group memory Awareness	Representation of knowledge Group memory Awareness
Role Assignment	None	None	None	None	None
Platforms	Virtual Reality CAVE Environment	Macintosh, UNIX	UNIX / X-Windows	WWW	WWW

Table 3: Classification of CSCL Environments according to Framework

From the above Table, we can stand out some observations:

- Most of the environments privilege the collaborative construction of some kind of knowledge, being based on theories of learning.
- The environments that develop elaborated models allow interactions of higher degree and combine another research areas' technique.
- The group memory and knowledge representation are present features in most of the systems.

6. Conclusions and Future Perspectives

Computer-supported cooperative learning is a relatively recent area of researches and there are not still complete theoretical frameworks that describe and structure its whole dimensions. In this paper, a framework that organizes the main aspects related to CSCL environments was discussed, in order to facilitate the study and analysis of them. It also aims to give directions for new environments building.

The work is inserted in the context of a wider study on CSCL area, whose objective is to define a more general framework embracing, besides the classification of learning environments, other themes related such as: software environments for development of cooperative learning applications; distance education, and computer-supported cooperative learning in organizations.

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Computer-Mediated Communication and Foreign Language Learning via Telecommunication Technology

Amy S.C. Leh
Department of Science, Mathematics, and Technology Education
College of Education
California State University at San Bernardino
San Bernardino, CA 92407
aleh@csusb.edu

Abstract: This study investigated (1) the difference of language performance and confidence of the participants who used computer-mediated communication (CMC) and who did not, (2) the content and appropriateness of CMC in distant learning, (3) the opinions of students and the instructor towards the use of CMC in instruction, and (4) the problems the participants encountered in the use of CMC. The participants were college students in the USA learning Spanish and communicating with college students in Mexico via e-mail for ten weeks. Data collection included scores of cloze tests, written reports, and oral examinations. Data also consisted of e-mail messages, survey, and interviews. The study revealed that CMC was beneficial for distant learning and that the students and the instructor were in favor of the use of CMC in instruction. A follow-up study was conducted one year after the initial study was completed. The results of the follow-up study supported the findings.

Introduction

Recent developments in electronic technologies have dramatically altered global communication. The technologies have changed how people communicate and also influenced how they learn. The Internet, which transcends international boundaries, allows people to communicate with audiences afar within a short time. It also allows everyone on the globe to join one big learning environment. E-mail, a computer-mediated communication (CMC) technology that relies on the Internet, has become the most common and the least expensive way to communicate and learn at a distance.

Is CMC appropriate for learning? Should educators encourage the use of CMC in instruction? Before answering these questions, one needs to understand the nature of CMC and social presence. Most CMC today is based on text and lacks nonverbal cues, such as facial expressions and gestures. Text-only e-mail communication is an example of CMC where the reader can not access the sender's emotions unless the sender expresses them in the text. Social presence is the degree to which a person feels "socially present" in a mediated situation. People feel intimate and share more if they feel socially present. However, when social presence is lacking, people recognize the impersonal environment and share less. Social presence is an important factor in distant learning and one of the four theoretical constructs in distance education (McIsaac & Gunawardena, 1996). Many scholars have addressed the topics of CMC and social presence. Two perspectives have emerged in the literature of CMC.

One perspective is that the lack of social cues in CMC is problematic. Rice (1984) and Trevino, Lengel, and Daft (1987) noted that the absence of social cues affected users' perception of communication context and constrained users' interpretation of messages. Many scholars noted that it is less appropriate to use CMC for personalized interactions which are needed in resolving disagreement, getting to know someone, or negotiation (Hiltz, Johnson, & Agle, 1978; Rice & Case, 1983; Rice, 1984; Steinfield, 1986). An argument can be made that since interactions are crucial to the learning process, CMC is inappropriate for learning. Research studies provide more specific information about the topic. According to Short, Williams, and Christie's (1976) study, when fewer nonverbal codes were available in a medium, the users paid less attention to the presence of other social participants. Hackman and Walker (1990) studied students in an interactive television setting, and they found that cues given to students such as encouraging gestures, smiles, and praise were social factors that enhanced students' learning. Without such cues, CMC can be "less friendly, emotional, or personal and more businesslike, or task-oriented" than other communication media (Rice & Love, 1987, p. 88). Appelbaum and Enomoto's (1995) study revealed that individual differences could not be highlighted via CMC. Ruberg, Moore, and Taylor (1996) noted that CMC limited student participation and interaction. Because of CMC's nature, researchers have determined that CMC is not appropriate for communication and learning.

The other perspective that emerges from the literature is that CMC is appropriate for learning. Gunawardena (1995) stressed that although CMC contained few social context cues, it could be perceived as interactive, active, interesting, and stimulating by participants. She suggested that student perceptions of the social qualities of a medium depended upon the social presence created by the instructors (or the moderators) and the on-line community. Many scholars have described advantages of using CMC in education. They noted that CMC users adapted to the medium and developed "on-line communities" (Hiltz & Turoff, 1978; Kerr & Hiltz, 1982) and that CMC messages were friendly and personal. An argument can be made that since CMC messages are personal and foster interactions which are crucial to the learning process, CMC is appropriate for learning. Some studies provide insight into the underlying process for CMC in education. Hiltz and Turoff's (1978) study presented cases where friendship and warm relations developed. Rice and Love (1987) found a significantly greater percentage of socioemotional content in a computer "bulletin board" than had been previously reported in experimental findings. Steinfield (1986) found that the need for communication across locations was associated positively with CMC messages. Johansen, DeGrasses, and Wilson (1978) reported that messages among participants on a network reflected participants' interests and attitudes and that network communication turned into friendships over time. Foulger (1990) reported that experienced computer users rated several text-based media, such as e-mail, as "rich" media. Ruberg, Moore, and Taylor (1996) found that CMC encouraged discussion among students. A study by Olaniran, Savage, and Sorenson (1996) indicated that students generated more ideas using CMC. Anderson and Kanuka (1997) concluded that CMC was beneficial for communication.

In summary, the literature provides support for two perspectives: that the lack of social cues of CMC is problematic and that CMC messages are personal and foster interactions. The former have not supported the appropriateness of CMC in communication and learning while the latter have. The study presented in this article extends our knowledge of CMC appropriateness in a distance learning environment by examining foreign language learners and by involving two nations. This study investigated (1) the difference of language performance and confidence of the participants who used CMC and who did not, (2) the content and appropriateness of CMC in distant learning, (3) the opinions of students and the instructor towards the use of CMC in instruction, and (4) the problems the participants encountered in the use of CMC.

The Study

Student Samples

The participants were United States (US) students who were enrolled in a fifth-semester Spanish Conversation and Composition course offered by the Department of Languages and Literatures at a large public university. Students in two classes participated in the study. They were taught by the same instructor on the same days. One class learned and used e-mail during the semester, and the other one did not.

The e-mail group communicated with students in Mexico via e-mail. The e-mail communication was conducted in Spanish and lasted for 10 weeks. A total of 18 US students were involved in the CMC and each had two Mexican pen-pals. They were encouraged but not required to communicate with their pen-pals.

The pen-pals were Mexican students taking a university mathematics class in Instituto Tecnologico y de Estudios Superiores de Monterrey in Mexico. The Mexican professor encouraged the students to communicate with the students in the United States of American (USA) and to find out how students in the USA learn mathematics.

Research Questions

This study asks the following questions:

1. Does the reading, writing, and speaking performance of the students using e-mail in class differ from the performance of those students not using e-mail in class?
2. Does the confidence of the students using e-mail in class differ from the confidence of those students not using e-mail in class?
3. What does the content of the students' e-mail messages involve?
4. What are the opinions of the students and instructor about using e-mail in foreign language learning?
5. What problems do students encounter during communication with their pen-pals via e-mail?

Procedures

At the beginning of the semester, the researcher explained the project to the students of the e-mail group, introduced the possible use of e-mail in foreign language learning, and expressed the hope that the students would choose to participate. The subjects were told that they were not required to participate in the study. If they decided to get involved in it, they had the freedom to stop it at any time. They had the choice of writing a lot using their e-mail accounts, or writing little, or even not writing at all. Students were told that they would write their e-mail outside of class so that the writing would not take up any class time. If they decided not to write, it would not affect their course grade.

To encourage the students to write more, the instructor agreed to give extra points up to ten percent of the total score for participating. The extra points were based on the number of the e-mail messages sent to the pen-pals and the amount written in the e-mails. To get extra points, the students were told that they should send copies of their e-mail messages to the researcher. After the explanations, all students volunteered and signed the consent letter. They filled in a demographic data sheet and an attitude survey form, and they participated in a cloze test.

The researchers repeated similar procedures to the non-e-mail group. The students also signed the consent letter, filled in the demographic data sheet and the attitude survey form, and took the cloze test. Since they did not use e-mail, their extra points were based on the number of articles they read outside of class and the amount of summaries they wrote.

Throughout the semester, both the e-mail and non-e-mail classes received the same encouragement from their instructor to conduct the out-of-class work for extra points. The project lasted for ten weeks.

At the end of the semester, the students in both the e-mail and non-e-mail classes answered the same cloze test and the attitude survey as at the beginning of the project. The e-mail group filled in an additional questionnaire to share their opinions about using e-mail in their classroom. They were informed that a telephone interview would be conducted to clarify the responses on the questionnaire. During the following days, all subjects were interviewed.

After the final examinations, the instructor provided the researcher with scores of both classes, including scores of all written reports and two oral examinations. Finally, the instructor was interviewed to share his opinions about the use of e-mail in his class.

Data Analysis

Both quantitative and qualitative research methods were used to analyze the data. The data analysis consisted of three major parts.

The first part is to answer the first two research questions. It included the use of statistical analysis to compare the language performance and confidence of the students of the e-mail group with those characteristics of the non-e-mail group. Both pre-e-mail and post-e-mail scores were obtained. Pre-e-mail scores included scores of the cloze test administered at the beginning of the research study, the first three written reports, and the first oral examination. Post-e-mail scores consisted of scores of the cloze test administered at the end of the research study, the final three written reports, and the final oral examination. A t-test was first used to evaluate whether the pre-e-mail scores of one group were significantly different from those scores of the other group. If there was no significant difference, a t-test was used to compare the post-e-mail scores of the two groups. If there was a significant difference, an Analysis of Variance (ANOVA) was conducted.

Due to the lack of a reliable language test, the evaluation of language performance of this study was based on the scores of the cloze test (reading), the students' written reports (writing), and the oral examinations (speaking). The cloze test consisted of paragraphs requiring students to fill in twenty key words. A total of 100 points were available. The reliability of the cloze test was checked by consulting with two Spanish experts. The students' writing and oral skills were graded by their instructor who used grading criteria agreed upon by all the instructors teaching the Spanish course and by the coordinator of the course. Because the instructors were Spanish experts, the reliability of those language scores was high.

The analysis of the students' confidence was based on the attitude survey. It consisted of 10 questions asking students to rate their confidence on their Spanish language skills and their knowledge of Spanish cultures. For each individual, the rating from each question was summed together into a total rating ranging from 5 to 50. The mean of the rating numbers of the e-mail group was compared with the mean of the non-e-mail group. The reliability of the attitude survey was checked by consulting with three reputable researchers. The internal reliability of the attitude survey was also checked by SAS. The Cronbach Coefficient alpha value of the attitude survey of the e-mail group before the e-mail communication was 0.95, and the alpha value after the communication was 0.93.

The values for the non-e-mail groups were 0.85 and 0.81. The values were high, and the items of the survey were reliable.

The second part is to answer the third research question. It involved the use of qualitative research methods to analyze the e-mail messages. The content topics in the e-mail messages were coded and categorized according to topics in the previous literature (Barson et al., 1993; Cononelos & Oliva, 1993; Kern, 1995). Topics in the literature included culture (e.g., values, beliefs), language itself (grammar, syntax), course management (due date, assignment), social activity (planning for a movie, a party), and so forth. In the process of coding and analyzing, other topics emerged, too. Further, the e-mail messages were analyzed in depth. The messages which were warm and friendly and which fostered learning and communication were coded and collected into specific folders.

The third part is to answer the fourth and fifth research questions. It consisted of reviewing and analyzing the data collected by survey questionnaires and interviews conducted in the e-mail group. The survey consisted of 10 questions with a scaling from one to five and three essay questions. The survey was designed to find the participants' opinions towards the use of e-mail in the study. The internal reliability of the questionnaire was checked by SAS. The Cronbach Coefficient alpha value was 0.82. This value was fairly high, and the items of the questionnaire were reliable. Interviews were conducted to clarify any ambiguous information.

Results

The quantitative results of the study indicated that there was no significant difference on reading, writing, and speaking performance between the two groups. The students' confidence of one group also did not significantly differ from that of the other group.

The qualitative results of the study revealed that CMC provided the participants with good language learning environment, motivated the learners, fostered learning, and encouraged communication. The content of the e-mail messages consisted of discussions about cultures (e.g. values, customs, and life styles) and Spanish language use, such as syntax and semantics. As several CMC researchers mentioned, many e-mail messages of the study also revealed that the participants developed on-line communities. Their messages were warm and friendly, and the participants became friends via CMC.

The results of the survey and the interviews indicated that the students in the e-mail group and the instructor were in favor of using e-mail in language learning. The students had strong desire of using CMC while the research study was conducted and after the study was completed as well. Many e-mail messages at the end of the semester appeared to be discussions about how to continue the CMC. The students unanimously supported the use of e-mail in foreign language learning and thought that e-mail was a good addition to their class.

Problems occurring during the semester were systematically recorded by the researcher. Some problems were successfully handled by the researcher and the professor in Mexico; for example, (1) the students' initial mail was returned as undeliverable and (2) some students did not receive their pen-pals' responses. Problems addressed in the study can be of interest to researchers or practitioners who wish to conduct similar projects. The following problems surfaced, for example, (1) several students had limited access to a computer, (2) some pen-pals lacked commitment of writing, and (3) the students could not use foreign characters in their e-mail system.

The Follow-Up Study

The follow-up study was conducted one year after the initial study. E-mail was sent to each of the students in the e-mail group. The students were asked to answer the following questions: (1) Did the student continue writing to the pen-pals after the research project was completed? (2) Was the student still communicating with the pen-pals via e-mail? and (3) How did the project affect the student over time? Four students answered the questions by e-mail, and ten students answered the same questions through the phone. Four students could not be located.

One third (four students) of the participants involved in the follow-up study said that they have continued writing to their pen-pals after the project was over. The communication lasted for a few weeks for two of the students and lasted for three months for one student. The fourth student was still communicating with her pen-pal when the follow-up study was conducted. Other students did not continue writing to their pen-pals because they were too busy to write or because their pen-pals did not reply.

All of the students reiterated that using e-mail in foreign language learning was a great idea and should be integrated into instruction. Several students reported that the project has positively affected them. Three students described exactly how the project influenced them.

One of the students mentioned that although his experience with his pen-pals in the Spanish class was "short lived," the project motivated him to make friends with people in Brazil and helped him to "remain in touch with the culture there." Another student stated that his pen-pals in the class were not "very responsive." However, he found other pen-pals and was writing to them weekly. He said, "Your study got me interested in writing to people, and I have found several lists [newsgroups] of Spanish pen-pals on the Internet." Another student mentioned that she was helping her daughter's school to connect with people in Mexico. She said that, without the experience with the research project, she could not help the school.

Conclusion

The research study revealed that e-mail (CMC) is beneficial for learning and communication. Although the participants lacked social cues, such as gestures, the participants developed on-line community for communication. The students used CMC to discuss cultural issues and language use with their pen-pals (Spanish native speakers) at a distance. CMC provided the participants with good environment for friendship, learning, and communication. The students and the instructor who participated in the study were in favor of the use of e-mail. The students had strong desire to use CMC not only while the research study was conducted but also after the study was completed. They unanimously agreed that CMC was a good addition to foreign language learning.

The results of the follow-up study, conducted one year after the research study, revealed the consistent positive opinions of the participants towards the use of CMC. They addressed again that CMC is beneficial for foreign language learning and should be integrated into foreign language instruction.

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Reusing Web Documents in Tutorials With the Current-Documents Assumption: Automatic Validation of Updates

David B. Johnson
U S WEST
450 110th NE, Room 714
Bellevue, WA 98004
Dbjohns@uswest.com

Steven L. Tanimoto
University of Washington
Box 352350
Seattle, WA 98195-2350
Tanimoto@cs.washington.edu

Abstract: This paper, based on the first author's Ph.D. dissertation describes an experimental system for authoring and delivering tutorials on the web under the assumption that the system should deliver the latest versions of the selected documents, even when they are not controlled by the tutorial author. The great richness of materials available on the web encourages reuse of web documents in tutorials. However, the dynamic, sometimes chaotic nature of the World Wide Web poses a new challenge for tutorials that depend on links to various people's or institutions' web pages. Therefore our system includes provisions for anticipation of various kinds of changes to documents or their availability. At time of tutorial delivery, our system validates web documents by evaluating differences between document profiles stored at authoring time and new profiles based on the current versions. If appropriately constructed, the tutorials can then adapt to the changed circumstances of availability or reliability.

Introduction

Motivation

The educational potential for the Internet has aspects that can be categorized under several headings: online library services and reference material, communication and conferencing, and online tutorials and courseware. These functions are interrelated and can easily be combined. For example, tutorials can make use of online reference material by including links to it. The Internet enhances opportunities for authors to reach distant and diverse audiences, and it makes it easy to combine and integrate resources found on the World Wide Web into tutorials.

This paper explores some of the issues involved in authoring and delivering tutorials via the World Wide Web that reuse documents found on the web. The World Wide Web is somewhat chaotic: web sites come, go, and evolve. Documents referred to in tutorials may change. The student's access to various web pages may not always be timely. One solution to these difficulties would be to encapsulate all documents used in a tutorial on a CD-ROM and distribute the tutorial on CD-ROM. This solution is appropriate for many situations, but it has some disadvantages. The encapsulated documents may become obsolete or if not obsolete then inferior to improved versions that get posted by their creators. There may also be legal restrictions placed upon the use of the documents that forbid their copying and distribution on CD-ROM. Finally, distribution by CD-ROM may not be as convenient as just-in-time downloading. Therefore it is sometimes appropriate to adopt the following assumption: documents referenced in the tutorial should be the latest available versions and should be retrieved when needed, without copying other than the normal caching performed by the browser and network relay sites. We call this the *current-documents assumption.* The current-documents assumption together with ubiquitous reuse of documents is the primary consideration that changes the nature of Web-based tutorial authoring from conventional tutorial authoring.

After we describe our experimental tutorial system, Wtutor, we discuss one of the technical problems that arise in web-based tutorials with the current-documents assumption: ascertaining to a reasonable degree of certainty that the information contained in a current document is consistent enough with that of the original document (the document at the same URL at the time of authoring) that the tutorial will not suffer any loss of effectiveness. We call this the validation problem. We provide a solution to this problem and describe our experience with the experimental system.

Related Work

Tutorial systems for reuse of World Wide Web documents have been created by several groups. The primary concern among these efforts has been providing means for navigating through the web of documents. The "Walden's Paths" system is one such program using this approach (Shipman et al. 1996). It uses a proxy server and CGI scripts to translate requests for tutorial documents into requests for documents from the World Wide Web. Paths are stored as linear lists of URLs. The path server not only fetches the documents from the web but also modifies them before they are displayed by the user's browser. The modifications include the insertion of new navigation links that, when activated, take the user one or more steps forward or backward along the path. A related system is Footsteps (Nicol et al. 1996). This system also uses CGI scripts to request and then modify incoming documents; however, rather than offering links to several documents along the path in the vicinity of the current document, Footsteps provides a link to an index to all of the documents in the path.

Another tutorial system for the web is Brio (Roscheisen et al. 1995). The BRIO system makes use of special documents called annotations. The tutorial author creates one annotation for each web document and specifies a connection structure by linking annotation documents to each other. A special browser is used that provides two panes for the user: one shows a list of links to annotated documents in the tutorial. The other shows the documents with their corresponding annotations superimposed.

These systems provide facilities for gluing web documents together into tutorials. However, they do not provide any support for meeting the challenges of the dynamic nature of the World Wide Web.

The Wtutor System

Our experimental system for delivering web-based tutorials is called Wtutor (Johnson 1997). Its two fundamental components are a tutorial control program and a modified web browser. The tutorial control program is written in Common Lisp. It holds a representation of the tutorial in terms of URLs and how they relate to one another as parts of the tutorial. The control program receives messages from the browser and also instructs the browser to load particular web documents. The modified browser serves as the interface between the student and the tutorial material as well as an interface between the student and the control program.

Each tutorial is represented using a structure we call the tutorial map. The map consists of a set of URLs (World Wide Web document addresses the adhering to the Uniform Resource Locator syntax), together with information about the relationships among the documents for purposes of the tutorial. Documents are ordered and can have alternatives specified. The author of a Wtutor tutorial can specify that URLs belong to groups of URLs. The groups can be used as elements of precedence relationships, implicitly specifying alternatives. The groups can also be labelled as "concurrent," meaning that all URLs in the group should be displayed simultaneously in different portions of the screen. For example, this permits commentary written by the tutorial author to appear in synchrony with a "reused" web document from a third-party web site. Tutorial maps represent the allowable flows of visitation through the portion of the World Wide Web of interest to the tutorial. They also contain information that supports effective validation of the documents used in the tutorial

The Validation Problem

As we have already discussed, the validation problem refers to the challenge of making sure that URLs included in the tutorial continue to serve their purposes in the tutorial even though the documents they point to may have been removed or may have been changed by their authors. Given the dynamic nature of the web, this is an important consideration in reusing web documents under the current-documents assumption that students see only documents just downloaded from their original sites.

Documents placed on the World Wide Web typically undergo changes after the times they are first posted. Sometimes these changes are trivial–minor adjustments to formatting or the correction of a few spelling errors. In other cases, significant portions of text are added or removed. Sometimes document are removed either because they were parts of temporary web sites (e.g., college student web pages that get removed when the student graduates) or because they were found to violate some copyright. In many and perhaps most cases, documents remain on the web and remain effective for their use in a tutorial. However, the challenge is to have a means for the tutorial delivery system to automatically make a reasonably reliable judgment about whether a document is still effective for the tutorial's purpose.

Approach to Validation

There are many ways in which a tutorial system could anticipate the kinds of changes listed above and respond to them. The simplest way would be to store a complete copy of the original document. This would allow comparisons to be done with existing tools such as *diff*, which could provide a detailed list of the physical changes to the document. Given the list of physical changes, it would still be necessary to infer the significance of the changes.

This approach has the disadvantage of consuming large quantities of storage space and consuming large amounts of bandwidth either at tutorial map retrieval time or at document validation time. A tutorial could easily contain hundreds of megabytes of data, which would have to be either stored on the student's local storage medium or on a central storage medium. The space requirements could be partially mitigated by the use of compression techniques on the document text, but this would still lead to significant space and transmission requirements. What is needed is a document signature that significantly reduces storage requirements while still providing enough information about the document that useful comparisons can be made.

Rather than storing copies of the tutorial documents, Wtutor creates digital signatures of each document when the document is first added to the tutorial and stores these signatures. When a reader is taking a tutorial, Wtutor retrieves the current versions of the tutorial documents, calculates the current signature and then compares the stored signature to the current to infer the level of change in the document.

Wtutor signatures

Wtutor takes advantage of the structural information provided in HTML documents to extract meaningful document signatures. In Wtutor, document signatures are composed of three elements: the checksums of the paragraphs of the document, the headings of the document, and any keywords the tutorial author chooses to specify. A sample signature is shown in (Fig. 1). Before extracting the signature, Wtutor normalizes the document by converting all the text to lower case and reducing each contiguous group of whitespace characters to single space characters.

URL	http://www.cs.washington.edu/research/metip/tutor.form.image.html
Paragraphs	(19316 47247 21696 47247 21696 33122 37527 38582)
Headings	(quantization sampling rate applying linear filters tutorial image request form)
Keywords	(NIL)

Figure 1 Sample Wtutor Signature

Other possibilities were considered for inclusion in the signature, such as the title of the document or the links contained within the document. The paragraph checksums, headings, and keywords were chosen as the elements that best provide information about the document.

Wtutor signature comparison method

Wtutor stores document signatures in the tutorial map. The tutorial author can run a procedure at any time to update the signature of any URLs in the tutorial map. When a student is using the tutorial, Wtutor validates each URL by comparing the digital signature stored in the map with the document's current digital signature. The comparison yields a numeric distance value, which indicates how much the document has changed.

For each element of the signature, Wtutor infers whether there have been additions, changes, or deletions. Once the number of changes, additions, and deletions in each category have been determined, they are combined according to the function in (Fig. 2). To allow for documents of different lengths, the function normalizes by the number of items of each type within the original document. This normalization recognizes that the scale of changes matters—adding five paragraphs to a document that originally had two paragraphs is generally much more significant than adding five paragraphs to a document that originally had fifty paragraphs.

dist = checksum dist + heading dist + keyword dist

checksum dist = checksum weighting factor *
(#chgs * chg_weight + #adds * add_weight + #deletes * del_weight) / #checksums

heading dist = heading weighting factor *
(#chgs * chg_weight + #adds * add_weight + #deletes * del_weight) / #headings

keyword dist = keyword weighting factor *
#deletes * del_weight / #keywords

Figure 2 Document signature distance function

The distance function also recognizes that some types of differences can be more significant than others by including a weighting factor for each type of difference. For example, it is probably more significant if a heading has been deleted from a document (implying that some segment of information is no longer provided by the document) than if a heading has been added (additional information is generally not a bad thing, unless so much is added that the original content is overwhelmed by the new).

The distance function also allows for the different elements of the signature to be weighted differently. A tutorial author may feel that the headings of a document are more significant than the paragraph checksums, since the headings provide more of an indication of the semantic content of the document. Another tutorial author may feel that no changes of any sort should be allowed, and choose to weight all elements equally. The Wtutor distance function provides the author the flexibility of choosing these weights.

Once the distance for a document has been calculated, Wtutor compares that distance to two defined levels: a warning level and a reject level. If the distance from the original signature to the current signature is less than the warning level, the document is simply displayed to the student. If the distance is greater than the warning level but less than the reject level, the document is displayed and a warning message is provided to the student indicating that the document has changed since its inclusion in the tutorial. If the distance is greater than the reject level, Wtutor first checks whether the document has an alternative. If an alternative has been specified in the tutorial map, that document is retrieved and displayed instead of the rejected document. If there is no alternative document, the rejected document is displayed to the student along with a message that warns the student that the document has changed significantly and may not be appropriate for the tutorial.

Testing the Validation Technique

The default values used in Wtutor for weighting the different types of changes in document signatures were selected after a set of testing with a small set of selected documents found on the World Wide Web. A set of artificial changes was applied to each of these documents, and then the signature comparison algorithm was used to compare the before and after versions of each document. Once the default weights had been determined and the warning and reject levels had been established, the validation technique was tested on examples of real changes to existing documents found on the World Wide Web.

Document life cycle

The first test case is a Web page describing Wtutor. There were five different versions of this document. The initial version (version 0) was a brief (72-line) description of Wtutor. Version 1 is essentially the same document, with a bit of rewording done. Version 2 adds introductory paragraphs to version 1. Version 3 is a User's Guide to Wtutor, which includes most of the material in version 2. This document was significantly larger than the earlier versions. Finally, version 4 of the document goes back to version 2, but adds links to sections of the User's Guide to Wtutor.

The distance measures for each of the versions of the Wtutor document are shown in (Tab. 1). These distance measures are the result of comparing the signatures of the versions to the signature of version 0. The distance measures do not exceed the warning level for versions 1, 2 and 4. This is a desirable result, as the changes in these versions are minor and do not significantly change the semantic content of the document. Version 3 exceeds the reject level. Again, this is a desirable result. While the semantic content of the earlier versions is included in version 3, the document contains so much more material that it is not really comparable to the other versions.

Version	Distance	Description
0	0.000	Original version; brief description of Wtutor
1	0.145	Slight rewording of version 0
2	0.209	Addition of introductory material to version 1
3	2.718	User's Guide to Wtutor
4	0.245	Back to version 2, with addition of links to User's Guide

Table 1 Distance measures for versions of Wtutor document

Sample tutorial

The second case in which Web documents were tracked over time was a sample tutorial about Dr. Martin Luther King. Although the tutorial was created primarily as an illustration of Wtutor's capabilities, it also served as a good test of the validation approach, because several of the documents that were selected for inclusion in the tutorial changed after the tutorial was originally created.

About a month after the creation of the tutorial, a running of the validation report for the tutorial showed the chronology document as having a distance measure of 0.007. This small distance is well below the warning level, so it did not have an impact on the tutorial. Upon investigation, the reason for the distance was found to be a correction of one of the dates in the chronology.

Two weeks later, another running of the validation report showed very large distance measures for several documents. All the documents from one site had distances in the 1.9-2.3 range, well above the reject level. Further investigation revealed that the owner of the documents had moved to a different site. The original site provided a note that the documents had moved, but did not provide direct links to the new locations. This required updating the tutorial map to point to the new locations for the documents.

In both of these cases, the validation method worked as desired. In the first case, the change to the document was recognized as small enough that the student was not even informed of the difference. In the second case, Wtutor recognized that the documents returned by the original server were not at all what the tutorial author wanted and notified the student of that fact. Without the validation, the student would not necessarily known that the documents returned were not what the tutorial author intended.

Two weeks later, a running of the validation report showed one document with a distance measure of 0.62, again above the reject level. Upon inspection, the document was found to have been updated by the owner. In the course of correcting several typos in the document, the author had significantly reformatted the document. In this case, the validation method returned a "false positive". The text portion of the document had not changed significantly, but the differences in markup were interpreted by the signature comparison as significant document changes. A student going through the tutorial would have received a warning message that the document might no longer be appropriate for the tutorial, but the document would still have been displayed to the student.

Author volunteered examples

In the final case of tracked Web documents, Web document authors were solicited via Usenet postings for participation in the experiment. Prospective participants were asked if they had Web documents that they were planning to update. Dr. Hubert Partl of the Universitaet fuer Bodenkultur in Vienna, Austria volunteered to participate and provided a list of the URLs for his documents. Dr. Partl's documents make up an HTML handbook.

A tutorial map that contained each of the URLs was created and document signatures were taken. Copies of each document were saved at the same time as the document signatures were taken so that actual changes to the documents could be tracked. During a six month study, periodic validation reports were taken to test whether the documents had changed since the initial document signatures were taken. At the same time as the validation reports were done the current versions of the documents were retrieved and compared to the original copies, so that the actual changes could be reviewed and the appropriateness of the resulting distance measure could be evaluated. The URLs for the volunteered set of documents are listed in (Tab. 2), along with two distance measures for each document. The intermediate distances are from compares done about two months into the measurement period; the final distances are from the compares done at the end of the measurement period.

URL	Intermediate Distance	Final Distance
http://www.boku.ac.at/htmleinf/hein.html	0.22	0.39
http://www.boku.ac.at/htmleinf/hein1.html	0.30	0.44
http://www.boku.ac.at/htmleinf/hein2.html	0.28	0.50
http://www.boku.ac.at/htmleinf/hein3.html	0.21	0.29
http://www.boku.ac.at/htmleinf/hein4.html	0.10	0.43
http://www.boku.ac.at/htmleinf/hein5.html	0.27	0.44
http://www.boku.ac.at/htmleinf/hein6.html	0.18	0.21

Table 2 Volunteered WWW document distance measures

How well do these distance measures reflect the changes that were made to the documents during the measurement period? The first observation is that only one version of the documents exceeds the default rejection level. This is a desirable result, as most of the changes to the documents fell into the categories of markup changes, spelling changes or corrections, rewordings for clarity, or minor additions. For most of the documents, the final versions exceed the warning level. This is primarily due to the number of minor changes that were made to these documents. The final version of hein2.html just reaches the reject level. The reason that this document exceeds the reject level is that it includes some deletions of headings and paragraphs.

The distance measures for the intermediate and final versions of these documents seem appropriate for the differences between these versions and the original versions of the documents. Overall, the Wtutor approach to validating documents provides a useful method of verifying that documents still fit within the tutorial.

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Acculturation in an Information Technology Discourse Community

Judith Walker
University Department of Rural Health, Tasmania
University of Tasmania
Australia
Judith.Walker@utas.edu.au

Quynh Lê
University Department of Rural Health, Tasmania
University of Tasmania
Australia
Quynh.Le@utas.edu.au

Abstract: Rapid advances in information technology and telecommunications (IT and T) are impacting on a changing world in which boundaries, whether they are at local, national and international levels are now less clearly marked. The so-called information superhighway is reaching and linking many regional, rural and remote communities so that the world itself has become a small global village. This leads to the assumption that the power of information technology and telecommunications is inescapable and unresistable. A logical response to a changing and challenging world is to prepare "global villagers" for acculturation into a new IT and T discourse community. However, potential IT and T users are human not virtual beings and fear, anxiety, confusion, resistance and inspiration are part of the acculturation process towards an IT and T discourse community. In this paper the concepts of acculturation and discourse community are discussed and applied to IT and T discourse generally and educational multimedia in particular. A paradigm shift is occurring in education with the introduction of IT and T, and strategies have to be developed to facilitate acculturation of new users to this paradigm to prevent hostility and rejection of the advantages they bring to regional, rural and remote communities. Three aspects of acculturation in education are presented and discussed. The implementation of acculturation in the context of IT and T is explored through a description of the provision of rural health education and training opportunities in the small Island State of Tasmania.

Acculturation as A Psychological Process

Mead in Williams (1972) defined socialisation as "a process by which human children born potentially human, are able to function within the societies in which they are born". However, socialisation is a rather broad concept. Williams (1972) discussed the fine distinction between socialisation and acculturation, arguing that the former refers to the process of transmitting human culture whereas the latter is the process of transmitting a particular culture. However, in an interactive world in which people of different cultures are engaged inter culturally, the question of cultural identity needs to be addressed. In an intercultural interaction, acculturation is a significant phenomenon. It is a process in which people of a different culture have adapted the new culture (Brown 1994). It is not a smooth process with feelings of confusion, resistance, and reluctance and sometimes suffering evident at all stages.

In education, acculturation takes place when learners from a different culture learn a new language or face a new educational paradigm that requires a partial or whole orientation to a new cultural discourse and become members of its discourse community. The acculturation process normally consists of the following stages, cognitively and affectively:

- *Conflict:* This is a shock stage as a new culture is rejected as a whole, due to negative attitudes towards the new culture.
- *Confusion:* This is the time when negative attitudes toward the new culture are challenged by other people or events, or when the new culture becomes a part of that person's life.
- *Exploration:* Accidentally or intentionally, a few 'things' about the new culture are discovered.
- *Familiarisation:* Learning more about the new culture in order to function well in it.
- *Acceptance:* The new culture has been accepted. The crisis has disappeared.

These stages are not necessarily sequential.

Acculturation in an IT and T Discourse Community

Swales (1990) presented six defining characteristics that are necessary for identifying a group of individuals as a discourse community:

- A discourse community has a broadly agreed set of common public goals that may be formally inscribed in documents or be more tacit.
- A discourse community has mechanisms of intercommunication among its members. The participatory mechanisms will vary according to the community: meetings, telecommunications, correspondence, newsletters, conversations etc.
- A discourse community uses its participatory mechanisms primarily provide to information and feedback.
- A discourse community utilises and in turn possesses one or more genres in the communicative furtherance of its aims. A discourse community has developed and continues to develop discoursal expectations. These may involve appropriateness of topics, the form, function and positioning of discoursal elements, and the roles texts play in the operation of the discourse community. In so far as genres are how things get done, when language is used to accomplish them, these discoursal expectations are created by the genres that articulate the operations of the discourse community.
- In addition to owning genres, a discourse community has acquired some specific texts. This specialisation may involve using lexical items known to the wider speech communities in special and technical ways, as in information technology discourse communities, or using highly technical terminology as in medical communities.
- A discourse community has a threshold level of members with a suitable degree of relevant content and discoursal expertise.

Swales' concept of discourse community can be applied to IT and T discourse. It is argued that IT and T does not exist in a cultural vacuum. It has become "a cult with its own esoteric language and rites, 'in' groups and 'out' groups, and above all faith in the intrinsic value of electronic communications" (Moran 1997). Aoki, Fase & Stowe (1998) introduced the term 'virtual micro culture' as a unique group dynamics, which arises as a result of frequent interaction and collaboration toward a common goal. It has its own culture and anyone who is exposed to it will go through a 'socialisation experience', namely acculturation. The stages described above reflect well the acculturation process experienced by its users when IT and T are introduced.

A review of the literature on the role of educational multimedia in the past decade supports the view that acculturation is a powerful phenomenon inherent in various experiences involving educational multimedia. While the business world has embraced IT and T wholeheartedly, educators, in comparison, have been rather slow in accepting them in teaching and learning. In some cases technological resistance occurs due to passive or active resistance to adopting technology (Allen 1997). Though the concepts 'teleteaching', 'virtual classroom', 'Internet-based teaching' have been introduced during the past decade and occur in various curriculum discussions, in reality the full adoption of IT and T into practice is still a long way off. Teaching is still conducted in a predominantly non-virtual context, in which the traditional resources are teachers, books and blackboards (or overhead projectors). But, significantly, there has been a mixture of feelings such as hostility, rejection, fear, and confusion among educators in relation to the use of IT and T in teaching and learning. According to a study by Holt & Thompson (1996), old attitudes, held by long-time serving staff, limited vision of what was possible in the flexible learning mode. To facilitate the experience of acculturation, it is desirable to start with a relatively clean cultural slate than to inherit a fully mature, but unreceptive culture.

There are three aspects of acculturation in education. Firstly, IT and T experts are contributing factors to the negative attitudes among IT and T prospective users. The worst case is when such experts hold the assumptions that IT and T is the magic solution to education and that teachers are secondary in the teaching and learning process. IT and T are therefore the magic wand, which can effectively replace teachers. The curriculum concept 'learner-centred' is sometimes confusing in the sense that it mis-signals a shift of significance from teacher as a primary source and learners as a secondary source. In other words, some may interpret learner-centred curriculum as role-oriented rather than process-oriented. This creates a misconception that IT and T can replace the teacher. However, if 'learner-centred' is interpreted as 'learning-centred', the emphasis is not on the comparison (whether implicit or explicit) of students' and teachers' roles, but on the process of learning itself. In this way, IT and T can play a significant role in improving learning in general and in enhancing positive attitudes towards IT and T in particular.

Secondly, a paradigm shift is occurring in education. According to Roberts (1997) this is "the rejection of one set of values and ideas about education and the adoption of a new set with regards to what constitutes effective pedagogy". This paradigm shift is occurring worldwide but faster in some parts than others depending on the availability of resources, existing infrastructure and the stage of development reached.

A new paradigm should not be regarded as old wine in a new bottle as it is not only the technology that counts but a new spirit with a new discourse community that has emerged. Therefore strategies have to be planned carefully to facilitate acculturation of current and prospective users to a new educational paradigm created by IT and T. Otherwise the acculturation experiences can be painful and sometimes destructive. As a result, hostility can be seen in headlines in the media such as 'students damaged computers

It is important to involve users in the curriculum-decision making process in their acculturation into an unknown or less familiar territory. In the past, IT educators have tried to reverse the direction of discourses by placing IT in the discourse of education rather than placing education in the discourse of IT. For instance, Moos' work has influenced the development and use of instruments to assess the qualities of the classroom learning environment from the perspective of the learner (Waldrip & Fisher 1997). Though IT and T can create a perfect virtual learning environment, learners should not be treated as virtual beings. They bring to a virtual class and the acculturation process their personal, social and cultural backgrounds, which shape their learning styles, educational attitudes, and interpersonal relationship.

Thirdly, there should be a good harmony between learning IT, learning about IT and learning through IT. Otherwise, the perception of IT and T in the curriculum will be challenged.

Stage 1: *Learning IT:*
This is a hands-on practical knowledge about IT and T such as word-processing, emailing, Web-navigation, scanning.

Stage 2: *Learning about IT:*
This involves concepts and issues relating to IT and T such as interactivity, ethical consideration, security etc.

Stage 3: *Learning through IT:*
This involves literature search, conferencing with teachers and peers, publishing etc.

These three aspects should not be treated in a linear progression. In other words, the syllabus should not proceed rigidly from stages 1 to 2 and 3. In an interactive dynamic learning process, users may start with their need to share with others their views on certain issues (learning through IT). Then they proceed with how to use the Web for interacting with others (learning IT). While doing this, they are aware of the use and limitations of the Internet (learning about IT).

Rural Health Education: an Example of Acculturation

We have discussed the concept of acculturation in relation to the culture of IT and T. Now the focus is on the implementation of acculturation in the context of IT and T and rural health education in Tasmania.

Thomson and Walker (1997) demonstrated the role of communications technology in health care provision through identification of various communications techniques and analysis of these in relation to health care delivery and health professional education. They showed how communications technology provides a logical link between education and health care delivery by acting as a tool for change to the knowledge, skills and attitudes of health care professionals towards rural health.

Walker (1998a) noted that the level, quality and cost of telecommunications infrastructure for rural and remote populations in Australia is being addressed via the Regional Telecommunications Infrastructure Fund (RTIF), known as 'Networking the Nation'. The aim is to reduce the gaps in the quality and cost of telecommunications services between metropolitan and rural Australia. She also explained how the Commonwealth Government in Australia is establishing and funding a number of university departments of rural health. In Tasmania, Australia's small, rural island state, a University Department of Rural Health was set up in late 1997. It acts as a catalyst for the development of a comprehensive and co-ordinated approach to rural health education, training and research across the State and across the range of relevant disciplines and professions. The aim of the Department is to provide access to education, training and support opportunities for rural health workers and trainees through an open and flexible learning framework supported by an IT and T base. It is built on a principle of partnership with health service providers and communities and is part of Tasmania's developing Telehealth Network to provide access to health services and rural health education services using technology as a tool. The Department has implemented a series of strategies to enhance the implementation of information technology and telecommunications in rural health. A top priority is acculturation into the new IT and T discourse community.

People who are involved in rural health care are drawn from:

- health professionals, directly responsible for patient care e.g., doctors, nurses, dentists, pharmacists, radiologists, pathologists and technicians;
- administrative and support staff involved in health care administration e.g., business managers, service development managers, patient information management officers and corporate strategists.

Increasingly, many of these people do not work in rural areas but are based in urban-based large hospital environments. Through Telehealth, services are provided at a distance and rural, locally based health care providers have a vital role to play in ensuring successful delivery of services and enhanced health outcomes. However, most health care workers do not have a sound understanding of the fundamentals of Telehealth and the use of IT and T for education purposes (Hasman & Albert 1997). Many exhibit feelings of hostility, rejection, fear and confusion in relation to use of IT & T in health care provision and access to education and training opportunities. This, in tune, reflects negatively on consumers of rural health services. It makes it difficult for practitioners to make decisions about the usefulness of applications and to express their needs in terms that can be understood by informaticians and IT and T personnel. Education and training in the place and use of IT & T is needed at a variety of educational levels, in different modes, for various professions in health care and with different types of specialisation.

In Tasmania, the Department of Rural Health and the State Department of Health and Human Services have embarked on a collaborative project. This will see the progressive roll out of Telehealth and IT and T education and training to meet an increasing demand for information management and the use of information and telecommunications technologies to enhance health services, to access education and training, and to assist in the acculturation process.

A major objective is to assist the change process to a health information management and information technology and telecommunications environment through training, including the use of IT and T to deliver training that is customised to workplace needs. It requires strategic planning across a range of services and collaboration in use of shared resources. It requires training that is based on the recognition of the role that acculturation plays in a new discourse community (Walker 1998b).

At the same time, the University Department of Rural Health is establishing a network of Rural Health Teaching Sites (RHTS) in collaboration with the Telehealth Network. The Department is facilitating rural health education and training programs for undergraduates (medical, nursing pharmacy and allied health students) in targeted rural areas and is building on the intellectual capital of these rural areas by providing on-going teaching, research and service development support to resident health care workers. Each Site has a defined catchment area and provides accommodation and learning facilities with computing, fax, internet access, audio and videoconferencing. An important part of the program is provision of training in the use of the technologies.

The three aspects relating to the role of IT and T have been taken into consideration: Learning IT, Learning about IT and learning through IT. Through the RHTS rural users have sound and reliable access to IT and T. Teleteaching and teleinteraction, with awareness and sensitivity to rural health issues and rural users, have been carefully planned and introduced. The Department's IT strategies have targeted rural health workers who have been disadvantaged by their isolation from the IT and T discourse community in rural health. For example, the Australian Physiotherapists' North-East Journal club runs internet access lunch time get-togethers to share the meaning making process about IT and T with local health staff and students. This event is organised and co-ordinated by the University Department of Rural Health. Without this effort acculturation into the IT and T discourse community will never take place.

Conclusion

IT and T is permeating deeply into various aspects of society. The IT-based superhighway is travelling to many remote parts of the world and has brought with it the technological power to make human communication dynamically interactive and effective. It has certainly brought people in the world much closer. However, the power of IT and T is often viewed without taking into consideration the potential conflict between IT culture and the acculturation experienced by those who are introduced to it. While IT and T can create many virtual experiences, we must remember that potential IT and T users are human not virtual beings and fear, anxiety, confusion, resistance and inspiration are part of the acculturation process towards an IT and T discourse community.

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IMPROVING TEACHING BY TELECOMMUNICATIONS MEDIA: EMPHASISING PEDAGOGY RATHER THAN TECHNOLOGY

Peter Jamieson
Centre for Higher Education Development,
Monash University, Australia.
<peter.jamieson@adm.monash.edu.au>

Abstract:
This paper reports the findings of a study of how university teachers approach teaching with one form of telecommunications media – cross-campus video conferencing. Typically, the assumption underlying training for teachers in the use of telecommunications media is that teaching will improve as a result of improved use of the technology. However, this study reveals that factors other than the role of the technology are crucial in determining the way teachers conduct their teaching. The study shows that a more pedagogically-oriented understanding of teaching with telecommunications media is needed to inform faculty development programs intended to improve teachers' approaches to teaching. The findings of this study have direct implications for the use of other forms of educational telecommunications media in university and other educational settings.

No medium, however useful, can solve educational problems. Media cannot alter the way teachers understand teaching (Ramsden, 1992, p. 161).

Introduction

The shift towards more *student-centred*, *open* and *flexible* approaches in university education, with their consequent reduction in on-campus attendance, is largely based on the capacity of telecommunications media to provide for various forms of real-time and delayed interaction (Mason, 1994). In light of this development, institutions face the significant task of supporting on-campus teachers experienced in face-to-face delivery in the development of effective approaches to teaching with one or more forms of telecommunications media.

The research reported in this paper was undertaken to inform the design of faculty development programs relating to teaching conducted by one form of telecommunications media – cross-campus video conferencing. Typically, telecommunications media are used to break down the classroom-student nexus by reducing contiguous teaching and learning situations (e.g. online courses).

However, cross-campus video conferencing teaching stands apart from most other uses of telecommunications media in a fundamental way and presents teachers with an enormous conundrum. As with on-campus education, it consists of a scheduled class in a fixed classroom location and involves group-based learning. The arrangement of the facilities and technology most commonly presumes a teacher-led lesson where the control of the technical facilities is placed at the teacher's disposal at the front of the classroom. Yet, this situation combines the teacher-student arrangement and synchronous interaction of the regular classroom with the teacher-student separation characteristic of distance education. Generally, it involves a group of students in attendance at the same site as the teacher forming a regular face-to-face class whilst the teacher is also physically separated from the other student group(s) gathered at a similar classroom facility. As in traditional distance education, often the teacher may have no direct, personal contact with any of the distant students throughout the duration of the course.

The literature on teaching by video conferencing has largely emphasised the primary role of the technology in the teaching process. The key assumption made by researchers and authors of training manuals alike is that the technology is at the core of teaching in these situations. From this perspective, teaching (and learning) will be improved by enhancing the teacher's skill in working with the technology (Cyrs, 1989; Ostendorf, 1995). Schiller and Mitchell (1993) claim that video conferencing 'requires a different teaching methodology from any that lecturers have used previously' (p 50). Overall, the emphasis in the literature and guides on how to teach by video conferencing is on *how* teaching happens.

Does a focus on the technology and how it is used result in the most effective approaches to teaching ? Is the technology the critical element of teaching by video conferencing? The present study is concerned with the way teachers understand teaching, in other words the meaning it has for them, when it takes places in the cross-campus video conferencing setting. It commences from the assumption that how teachers make sense of the context within which they act is integrally linked to how they approach their teaching.

Considerable research has been conducted into university teaching and learning over the past three decades (Entwistle & Ramsden, 1983; Marton et al., 1997). One of the key ideas to emerge from this research is that the *content* of student learning (*what* is taught) logically precedes the method of teaching content (*how* it is taught) (Ramsden, 1992). In other words, without a content to teach, there is no teaching method. From this perspective, at the core of the teaching process, including when it involves the use of any form of telecommunications media, is the way the students are brought into engagement with the specific content of their learning by the teacher. The teacher's critical role concerns the way in which the content is represented to the students, and how they structure the student learning experience. Previous research into teaching with telecommunications media has paid little or no attention to these elements by narrowly conceptualising the teacher as the user of a technology through which the teaching is conducted.

Providing an overview of the pedagogically-focused research, Ramsden (1992) says effective university teachers:

- engage the student at the appropriate level of their understanding;
- focus on key concepts, and students' misunderstandings of them, rather than covering the ground;
- enthuse students to make the material being taught interesting and stimulating;
- explain the material in simple, concise ways;
- use methods and set tasks which require students to learn actively and collaboratively;
- provide high-quality feedback on student work; and
- use valid assessment methods.

Researching teachers' experience of teaching by video conferencing

One of the most influential approaches to research into teaching and learning in higher education has been undertaken within phenomenography. This qualitative approach to research developed in Sweden in the early 1970s and grew out of a concern with the relationship between the ways in which students approached learning and the learning outcome. Phenomenography assumes that the world, or aspects of it, do not exist in isolation from the individual experiencing it. Rather, the only world that can be known to the individual (and the researcher) is an experienced, and therefore an interpreted, world. Phenomenographic studies focus on individuals' descriptions of their experiences of a specific phenomenon. The aim is to describe the qualitatively distinct ways in which a phenomenon has been experienced or understood (phenomenography uses these terms interchangably) by a particular group of people.

Phenomenography contends that some ways of understanding a phenomenon, or aspects of the world, are more sophisticated than others; and for this reason it has been used overwhelmingly in educational studies. In more than two decades, phenomenography has developed a rich heritage of studies primarily concerned with aspects of student learning and, more recently, teachers' approaches to teaching (Marton & Saljo, 1976; Trigwell & Prosser, 1997).

From the phenomenographic perspective, teachers do not simply teach differently by cross-campus video conferencing. Rather, teachers *experience* or *understand* the phenomenon of teaching by cross-campus video conferencing in fundamentally different ways. The variation in how teachers approach their teaching, in other words which aspects of the situation they are most concerned with, reflects the different ways they *experience* or *understand* teaching in that situation. With phenomenographic data drawn from empirical research, it is possible to conduct faculty development programs which aim to shift an individual teacher's *experience* or *understanding* of the phenomenon of teaching by cross-campus video conferencing to one which is more pedagogically sound.

The present study

The present study was concerned with the teachers' perspectives of their experience of teaching by video conferencing. It aimed to identify which aspects of the teaching process teachers were most concerned with, and which most affected teachers' approaches to teaching, in the cross-campus video conferencing classroom situation. The study asked the question: How do teachers experience, and make sense of, teaching by video conferencing? It involved ten examples of university teaching by cross-campus video conferencing and included twenty-three teachers.

The study was based primarily on open-ended, semi-structured interviews. Teachers were interviewed prior to a specific class. Based on the view of teaching underpinning this study, the interviews initially centred on the content to be taught, how the teachers intended students to learn that content, whether their teaching by video conferencing differed to teaching in the regular classroom and, if so, how? These aspects of the teaching (and learning) process were not conceptually separated from the teacher's use of the technology, but were seen to provide the rationale for its use. The class was subsequently observed, and a post-class interview was conducted to discuss what had occurred.

What is at the core of teaching by cross-campus video conferencing?

The teachers in the present study focused on a number of critical elements of the teaching process when teaching by cross-campus video conferencing. In contrast with the research literature's fixation on the technology, the study showed that teachers had a primary focus on one of three broad, distinct aspects, with critical distinctions in each category. They were:

The teaching environment.

Several teachers were predominantly concerned with the physical context of the video conferencing classroom, including the technology, the method of communication between linked sites, and the arrangement between, and the governance of, the physically separated classrooms.

Given its critical role, it is not surprising that the technology was the primary concern for some teachers. From the phenomenographic perspective of this study, these teachers can be said to have the least sophisticated understanding of teaching by cross-campus video conferencing. They were preoccupied with the affect of the technology on their own role as teacher. Any difficulties found in the teaching environment were viewed in terms of the inconvenience caused to the teacher, rather than in terms of the impact on student learning. In particular, the teachers felt a massive dependence on the technology which related to the reliability of its operation, rather than how teachers would use it. Prior to each lesson teachers were uncertain whether or not the class would be convened until the video conferencing technology established the link between distant sites.

Furthermore, some teachers' understandings of what constituted the technology extended to the technical support staff who were the embodiment of the teachers' dependency. Teachers felt that they had little or no control over the operation, maintenance and update of technical facilities. Unlike the regular classroom, where the teachers felt they had considerable autonomy over their teaching, the video conferencing classroom was predominantly the domain of the technical support staff where teachers were relegated to a secondary role. On another level, the teaching and learning environment was also formed by the medium of communication provided by video conferencing. Some teachers spoke of the barrier it created for communicating between participants compared with the regular classroom; particularly the difficulty in reading facial expressions and problems in hearing student responses.

A further problem related to the two or more classroom sites joined electronically and the problems teachers faced in managing student activity and measuring student responses to set tasks undertaken at distant locations.

How does a focus on the teaching environment affect a teacher's approach to teaching? Because of the comparative complexity of the video conferencing classroom and its impact on their own role, these teachers had an extremely negative view of teaching by video conferencing. The teachers adopted a very didactic, information-delivery approach which relegated students to passive transcribers of a presentation made by the teacher at the front of the classroom. The students in these classes were presented with no opportunity to influence any aspect of the teaching and learning process.

Importantly, these teachers treated the physically separated student groups as distinct classes joined electronically, rather than as a single, unified class. As a consequence, those student groups remote from the teaching site received relatively less attention from the teacher and were reduced to distant observers of a process which centred on the teacher's immediate physical location.

Teachers in this category made no attempt to work collaboratively with teaching colleagues in the design or delivery of their teaching programs. Instead, the teaching input was largely governed by each teacher's physical location and can best be described as sequential, with various teachers making individual contributions to specific sections of the program. Equally, these teachers made no effort to co-operate with technical support staff to ensure a more effective use of the facilities.

The teaching process.

Teachers in this category had a more sophisticated view of teaching by cross-campus video conferencing than those with a focus on the *teaching environment.* They were primarily concerned with their own role as teacher in the video conferencing classroom. These teachers either focused on replicating their previous teaching practice in the regular classroom in the new situation; or were intent on improving their current practice to become better video conferencing teachers.

Although they were not concerned with the impact of the environment on their own performance, they remained fixed on what they would do as teachers in the situation, rather than the implications this may have for the quality of the student learning experience. Teachers with this focus did not make a direct link between the teaching process and student learning.

How does a focus on the teaching process affect a teacher's approach to teaching? Some teachers in this category simply attempted to transfer previous classroom teaching practice into the video conferencing environment. They saw the context as one which accommodated their existing practice. However, in doing so the teachers failed to take into account the specificity of the circumstances (ie. multiple student groups; more than one teacher; different requirements for responding to distant students; the impact of the telecommunications media on interaction) due to their concern with their own teaching role.

Other teachers in this category did make adjustments for peripheral elements of the new environment (ie. changing forms of text and graphics to comply with presentation methods). However, in these instances the changes were similarly driven by a primary concern with their own teaching role, rather than the potential to enhance student learning. Although in relative terms they worked in closer co-operation with teaching colleagues, these teachers did not seek to maximise the potential for working collaboratively with other teachers who were also engaged in the subject, or with technical support staff.

Student learning.

From the perspective underpinning this study, a *student learning* focus is the most sophisticated and preferred way of experiencing or understanding teaching by cross-campus video conferencing. In this category, teachers were overwhelmingly concerned with the student learning experience, rather than environmental factors, or their own role as teacher. In addition, some teachers saw in the new situation the prospect for improving student learning by enhancing the technical system, or by incorporating video conferencing to enable additional chances for student interaction and participation.

How does a learning focus affect a teacher's approach to teaching? Teachers with a *learning* focus placed the student learning experience at the heart of their practice. The video conferencing classroom became a setting in which they aimed to actively involve students in their own learning. Teachers with this focus viewed the situation very positively, and sought the advantages it offered to students. Their teaching was conducted as facilitation, in which their role was to maintain momentum in a class which was driven overwhelmingly by the students' contributions and interests. As a result, these teachers recognised the value of close collaboration in the teaching process through which students would gain access to a wider range of expertise and knowledge regardless of their physical proximity to an individual teacher.

Teachers with a *learning* focus were aware that the situation of multiple student groups provided an opportunity to engage students in ways which would enhance the learning experience of the total group. Most importantly, teachers with a *learning* focus were the only ones to encourage and expect students to operate the technology of video conferencing, thereby further reducing the role of the teacher in that classroom setting. These teachers emphasised what student would do in the context, rather than their own operational or presentational skills, and worked closely with technical support staff to ensure the most efficient and effective environment for students.

Implications for improving teaching by cross-campus video conferencing

The concept of what teaching is in the video conferencing classroom needs to be seen by researchers and faculty developers as a pedagogical process rather than a technical one. Faculty development programs relating to telecommunications media have concentrated on improving teachers' operational and presentational skills for one simple reason: it has been assumed that this is the most important and distinctive feature of teaching in these contexts. The findings of this study give cause to reconsider the design of faculty development programs relating to teaching by video conferencing, and the principal assumption underlying such programs.

Teaching by video conferencing should not be conceived primarily as the act of using a telecommunications medium effectively. Although teacher proficiency with the technology will assist student learning, the teacher's response to other key aspects of the teaching process has a much greater impact on their approach to teaching. Where the technology *is* the primary concern, this study shows that teachers' understanding of the technology is much more complex than the literature generally acknowledges (ie. it creates the method and form of interaction).

Clearly, some ways of seeing the act of teaching by video conferencing are more preferable than others. From a broad phenomenographic perspective, faculty development programs should be based upon the present findings that teachers have a range of primary concerns, or ways of experiencing teaching by video conferencing. The aim of faculty development programs firstly, should be to establish how individual teachers understand teaching in that context, rather than assume that the technology is the predominant concern for all. Then, teachers should be made aware how other teachers in the program understand teaching by video conferencing, thereby introducing each teacher to the range of understandings, and the implications for how teachers approach their teaching. Ultimately, the intention should be to shift the teacher's understanding to a more sophisticated one. Faculty development programs should aim to produce a student learning focus where the teacher is fundamentally directed to how students will be brought into engagement with the lesson content in the relative complexity of the video conferencing classroom. Faculty development programs should also address several of the key issues to emerge from the present study which are directly related to how teachers approach teaching by video conferencing. For instance, there is a clear need to promote a view of the separate student groups as a single, unified class. Such an approach emphasises the value of the group-based learning experience, which is the essence of the video conferencing classroom, where the aim should be to generate interaction between all students. In group-based learning contexts, interaction should be the intention, and the group members viewed as sources of knowledge and experience to be utilised for the common good.

Finally, the study demonstrates that teachers need to work collaboratively in the design and teaching of a program, with all teachers assuming responsibility for the learning of the whole student group. Faculty development programs should directly address the concept and process of *team teaching* rather than assuming that collections of teaching colleagues will necessarily work effectively. In order to have the greatest impact of student learning, faculty development programs should be directed at course or subject teams rather than individual teachers. The concept of collaboration should also extend to the role of technical support staff who have a major role in assisting teachers to function effectively in the video conferencing classroom, and who should be regarded as members of the teaching team in development programs.

In broader terms, the approach to conceptualising and researching teaching by video conferencing reported in this paper also has major implications for other forms of telecommunications media as well as other educational sectors.

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A Study of the Impact of a School District Computer Technology Program on Adoption of Educational Technology

Catherine Suen, M. Ed.
Edmonton Public School District, Edmonton Alberta Canada
catherinesuen@yahoo.com

Michael Szabo, Ph.D.
University of Alberta, Edmonton, Alberta Canada
Mike.Szabo@ualberta.ca

Abstract: The purpose of this research was to assess the impact of a school district technology initiative on the adoption of computer technology as an innovation for teaching and learning. A review of the literature suggests that instructional technology is not widely implemented in the educational setting. The Board of Trustees of a large school board in Western Canada operated a district Technology Incentive Program (TIP) from 1996 to 1999. This study assessed the impact of the first year of TIP. The data were collected through quantitative and qualitative methodologies. The results showed that there was an increase in TIP participants' perception of the level of expertise in using a computer and usage of computers for teaching and non-teaching purposes. Results were discussed in terms of theories of change and innovation.

Introduction

The purpose of this research project was to: (a) examine the effects of the Technology Incentive Program (TIP) on selected aspects of the implementation of computer technology by teachers, and (b) make recommendations to school districts to encourage teachers in adopting computer technology.

In Western Canada, one large school district initiated a multi-year Technology Incentive Program during the school year 1996-1997, for teachers who were novice users of computer technology, to gain experience in using computers. The Board of Trustees approved a three year district project which provided teachers with computers and in-service training to encourage them to adopt computer technology in teaching.

With the advance of computer technology, educators are feeling pressure to use computers in the classrooms. Some parents are demanding changes in the curriculum. They want computer technology to be integrated into the curriculum so that their children will be ready to meet the challenges of an information society once they graduate. Means and Olson, (1994), Szabo & Schwarz (1997), and the U.S. Congress, (1995) have shown that, although computers are generally available in schools, a substantial number of teachers are either not using computers as tools for teaching, or the use of computers is at low level (e.g., word processing). Some school districts are looking for ways to support teachers so they will adopt computer technology into the instructional process.

Research Question

This study was designed to address the question: What impact did the first year TIP have on teachers with regard to computer usage? The research question was broken down into ten sub-questions so that the impact of the first year of the TIP could be examined in detail.

Sub-questions dealt with (a) changes in skill and knowledge in computer usage, (b) usage of computers for teaching, (c) usage of computers for non-teaching purposes, (d) the impact of having a computer for one year, (e) teachers' attitude towards computers, (f) TIP participants' purchase of computer as result of the TIP, (g) the TIP training program, (h) interest shown in computer-related activities, (i) other factors which influence the use of computers, and (j) computer usage and teachers' perception of what they need.

Review of the Literature

The review of the literature shows that the implementation of computer technology should be looked at as an embedded innovation problem within the process of change. Research is needed in the adoption and implementation of computer technology and on the impact of computer technology programs at district and local levels. The review and research drew heavily from the work on change and innovation of Fullan (1991, 1992), Rogers (1995) and Szabo (1996).

Study Methods

Data were gathered from a survey of TIP participants for an ex post facto study. To add depth of understanding to the study, seven TIP participants were also interviewed.

Sample of Study

The target population consisted of teachers who were novice-users of computer technology and would volunteer to participate in programs similar to the TIP. The accessible population was comprised of: (a) teachers who participated in the TIP in a large school district in Western Canada, in 1996/1997 and (b) teachers who applied for the program but were not selected (non-TIP).

There were 148 (64%) TIP teachers and 20 (14%) non-TIP teachers who responded to the survey. Seven TIP participants were chosen, based on grade levels taught to gain an insight into the impact of the TIP at the different grade levels, to be interviewed.

The impact of the program was defined by the (a) change of perception of teachers in the skill and knowledge or level of expertise with computer usage, (b) change in the number of hours of computer use for teaching purposes, (c) change in the number of hours of computer usage for non-teaching purposes, and (d) attitude toward the use of computers shown by surveyed teachers .

Hypotheses

It was hypothesized that TIP participants exhibit a difference before and after the TIP, with regard to (a) their perception of their skill and knowledge in using a computer, (b) the number of hours in computer usage for teaching purposes, and (c) the number of hours in computer usage for purposes other than teaching.

It was hypothesized that Non-TIP teachers exhibit a difference before and after TIP, with regard to (a) their perceptions in the level of knowledge and skill in using a computer, (b) the number of hours they used the computer for teaching purposes, and (c) the number of hours they used the computer for purposes other than teaching.

The Technology Incentive Program

In July, 1996, a large school board in Western Canada approved $753,000 to operate a TIP in which 230 teachers were given a computer and software productivity suite for their personal use for one year and approximately three weeks and four Saturday sessions of training in its use. Due to the funding limit, the administrator of the school was asked by the district to nominate some of the teachers who volunteered for the program. Of the 371 novice computer users nominated by their schools, 230 were successful in applying for the program.

The summer workshops included sessions on: (a) unpacking and setting up the computer system, (b) the operating systems of either Windows 95™, with MS Office™ or Macintosh™ system 7.5, with ClarisWorks™, (c) how to use word processing software; (d) electronic presentation; (e) CD-ROM resources such as Encarta and Canadian Encyclopedia, and (f) the Internet. Saturday workshops were offered in language arts, mathematics, science, and social studies to teachers in Divisions One and Two (grades one to six). Workshops on word processing across the curriculum, spreadsheets, database were offered to teachers of Divisions Three and Four (grades seven to twelve).

Data Analysis

Response Summary

Five TIP teachers were not accessible due to moving or leaves of absence. Of the 150 surveys returned by the TIP teachers, 148 (64%) were usable for data analysis. Of the 21 surveys returned by non-TIP teachers, 20 of them (14%) were usable for data analysis. The majority (76%) of the TIP participants were female and that 69% of the TIP participants were elementary teachers (43% taught in Division One and 26% in Division Two).

Analysis of Data

A comparison of the data was made by using paired t tests on *the level of expertise with regard to computer technology* the TIP participants perceived they had, before and after the TIP training. Comparison of the data was also made by using paired tests on *the number of hours the TIP participants used computers*, for teaching and non-teaching purposes, before and after the TIP training. The same procedure was used for the both TIP and non-TIP participants. A comparison across TIP and non-TIP teachers was not made due to the vastly different sample sizes.

Presentation of Findings: Survey of TIP Participants

Results for TIP Participants: Level of Expertise and Computer Usage

Results of t tests showed that the TIP seems to have made a significant impact on the participants with regard to their self-reported knowledge and skill in using a computer. The TIP also seemed to have made a significant impact on the participants with regard to the use of computers for teaching and non-teaching purposes.

Results for TIP Participants: Attitude and Confidence in Computer Usage

The TIP participants reported being more confident in using a computer. They also reported being more proficient in using a computer and exhibited a more favorable attitude toward computer technology for teaching and learning. An overwhelming majority of TIP participants held the opinion that computers should be used for learning (89%) and that the computer is an effective tool for teaching and learning (92%). However, only half of the teachers agreed that they were confident with using computer technology in delivering instruction.

Impact of TIP Training Program and Interest in Computer-related Activities (TIP Participants)

The TIP was reported to have made positive impact on its participants regarding the use of the Internet, clip art and word processing. It neither made a great impact on integrating computer with content area nor with the computer applications of spreadsheets, data bases or transferring data between applications. The TIP appears to have increased participation in computer related activities such as reading books, articles or magazines, and attending conferences on computer technology. As well, the TIP computer, a component of the TIP program, appears to have influenced some participants toward the purchase of a computer.

Factors of Usage (Other Than TIP) for TIP Participants

When asked about influential factors other than the TIP, TIP participants identified a necessity to learn to use computers for report card purposes and needs of students along with help from family, colleagues and friends and having access to computers in school or classroom.

Perceived Needs of Teachers (TIP Participants)

Participants in the TIP indicated requirements for (a) people support, (b) help in applying technology in classroom, (c) access to hardware and technical support, (d) training strategies, and (e) school and administrative support.

Summation of Discussion of Data from TIP Participants

Findings from Quantitative Data

The findings of the impact of the TIP were generally compatible with the theories of change and innovations as suggested by the review of literature. Teachers adapted to the process of change in their early attempts to adopt computer technology as an innovation as a result of the impact of the training from the TIP. However, there are many other factors in a complex social structure, such as a school district, which affect the change process. While it was not possible to completely isolate the effects of the TIP from this milieu of complexity, the TIP seems to have had a not insignificant impact.

Findings From Interview Data

Interviewees had different reasons for their participation in the TIP. Overcoming of the fear of technology, a change to a positive attitude towards using technology and an increase in teachers' use of computers were some of the significant outcomes of the TIP. Teachers perceived that they need help in the implementation of technology with curriculum. The interviewees identified barriers which prevented them from the successful implementation of computer technology in their classrooms. In general, the findings support the conclusions made by Szabo and Schwarz (1997) which stated that in addition to training, teachers require a broad range of support (infrastructure) and the ability to adopt the innovation to unique needs (a form of empowerment) (Tyack & Cuban, 1995).

Discussion of Results of Non-TIP Group

Non-TIP teachers reported increases in knowledge and skill in using a computer for personal and teaching purposes. They seemed to have gained more confidence in using computer technology and acquired a more favourable attitude towards computer technology for teaching and learning.

Non-TIP teachers appeared to participate in computer related activities such as reading books, articles or magazines, and attending conferences on computer technology. They also seemed to have increased the usage of word processing. However, they did not seem to show much increase in their use of the multimedia software and the application programs of transferring data between applications, spreadsheet or database.

The non-TIP group identified usage of computer for report card as one of the factors which increased computer usage. They identified lack of time as a reason for prevented them from increasing their use of computers.

Non-TIP teachers reported that, in order to increase the use of computers with their students, they needed (a) people support, (b) help in applying technology in classroom, (c) access to hardware and technical support, (e) training strategies, and (f) easier scheduling of facilities.

Summation of Discussion of Findings of Data From Non-TIP Teachers

Of the 21 surveys returned by non-TIP teachers, 20 of them (14%) were usable for data analysis. Since the sample of Non-TIP teachers was low, it cannot be assumed that the sample of the twenty teachers is representative of the Non-TIP population of teachers. Therefore, the comparison of the two group of teachers, TIP and Non-TIP teachers, was not made. The validity of the findings of the Non-TIP group is also questionable, due to the small sample.

There are several factors to suggest the gains made by the non-TIP teachers. A close examination of the returned surveys from the Non-TIP respondents revealed that three of the respondents received training, support and had access to hardware similar to what the TIP participants had received. These three Non-TIP respondents constituted to 15% of the sample for the Non-TIP group. The fact that the three teachers were given all the support they needed could be a confounding factor because of the 'rippling effect' of the TIP program.

Since principals knew about the existence of the TIP program, they might be trying hard to keep up with what was happening in the district by giving teachers who volunteered for TIP but were rejected by TIP as much support as they could afford to give. This could very well have been a confounding factor to the findings of the Non-TIP group.

There are several factors to suggest the gains made by the non-TIP teachers. Since the non-TIP group originally volunteered for participation in TIP, their motivation to adopt computers as an innovation was likely as high as the TIP participants. The concomitant popularity of the Internet might have been a catalyst in causing the non-TIP teachers to try to learn more about computers on their own. The fact that over one third of the teachers identified the usage of computers for report cards showed that there was a need for the non-TIP teachers to adapt to the changing process of using computer technology in their classrooms. Another possible factor is the fact that money and training were committed, which was likely interpreted as a signal of the importance of technology to the senior administrators (Szabo, 1996). This is in stark contrast to a common reaction of "There's not enough money in the budget for computers."

All the above mentioned factors combine to suggest why the non-TIP group seemed to have gained confidence in skill and knowledge in their ability to use the computer and have shown a tendency to adopt computer technology as an innovation for teaching and learning.

Conclusion and Recommendations

This study was concerned with the research question, "What impact did the TIP have on teachers with regard to computer usage?" The TIP impacted teachers' usage of computers in a significant way because it addressed the needs of the teachers in the implementation of computer technology by supporting them in their adaptation to the process of change. The TIP was the beginning of a process in which teachers began the adoption of computer technology in their classrooms. An analysis of the TIP, from findings of quantitative and qualitative data of this study, showed that the main reason for the success of the TIP was that the implementation of computer technology was looked at as an embedded innovation problem in which teachers had to be adapting to the process of change. Teachers were involved with the change process. They knew what the innovation was. Their training, organization and resource needs were beginning to be met within the TIP. They were given the time to try the innovation for a one year period so they could make informed decisions as to whether to adopt or reject the innovation. More teacher input into decisions about the content of the inservice program for the inservice sessions would be helpful for future programs modeled on the TIP.

As TIP participants demonstrated the characteristics of adopters of the innovations of computer technology for teaching and learning, the challenge of institutionalization lies ahead for the school district which initiated the TIP. As recommended by Fullan (1992), the ultimate adoption of an innovation for implementation was the institutionalization of the innovation. Institutionalization of an innovation is a process in which the innovation is fully implemented by members of the group with support from the institution or community in which the members are involved. The major contribution of the TIP was the impetus which initiated the implementation of computer technology as an educational innovation in a large school district.

Recommendations

Szabo (1996) proposed a model which begins with a vision from the senior administrative level, followed by the development, training and support of strategically placed leadership teams who are empowered to make the vision a reality in their own schools. Szabo's model could be considered for the implementation of computer technology in the classroom.

From a case study of implementation of new educational technologies in Ontario schools, Fullan (1992) suggested that teachers' requirement for organizational, resource and training support must be met in order for them to successfully implement technology as an educational innovation. In conclusion, the first Technology Incentive Program, though significant in its impact as to the influence it had on teachers with regard to their computer usage, is but a first step in the right direction. The school district must accept the challenge of supporting teachers with the further implementation of computer technology by helping to institutionalize the new technology for the school system.

Significance of the Study

The significance of this study lies in (a) its contribution to classroom practice by gathering data on how teachers attempted to implement computer technology in their classrooms within the TIP, and (b) its contribution to theory by relating a district initiative technology program with the theories of change and innovation in education.

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REPORT ON A CHANGE SYSTEM: THE TRAINING, INFRASTRUCTURE AND EMPOWERMENT SYSTEM (TIES)

Michael Szabo, Ph.D.
University of Alberta, Edmonton, Alberta Canada
mike.szabo@ualberta.ca
Terry Anderson, Ph.D.
University of Alberta, Edmonton, Alberta Canada
terry.Anderson@Ualberta.ca
Annette Fuchs, M.Ed.
University of Alberta, Edmonton, Alberta Canada
annette.fuchs@ualberta.ca

Abstract: This study presents the rationale, model and results of the first year of operation of an operational change model based in innovation. The change model focuses upon professional development of faculty in the area of alternative delivery systems. The two main components of TIES are the development of and commitment to a vision for change using alternative delivery systems and a leadership team training approach whereby faculties may interpret and develop the vision according to their own unique needs and goals. Results of the first year of operation in terms of vision development and leadership team training and support are presented.

Overview

The philosophy of TIES is that the process of change is equally or more important than training or resources to faculty use of alternative delivery systems. While numerous theories of change have been put forth in the literature, there are few working examples of comprehensive application of the principles which derive from the theories.

The purpose of TIES was to design and test a system for change in a university environment. The system is based upon 1) innovation change theory, 2) a workable, not just theoretical approach, 3) content taught is alternative delivery systems, 4) change methodology, 5) both top-down and bottom-up operation, 6) professional development and 7) empowerment through leadership training.

There are two major intended goals of TIES. The first is that the chief academic officers identify a vision for alternative delivery systems of instruction for the university, publish that vision widely, and demonstrate their commitment to it in a clear and convincing fashion. Secondly, departments within the university create leadership task forces to interpret the vision for their unit and prepare colleagues to implement the shared vision.

TIES was devised in 1996 by the Project Director during a sabbatical leave and through LEE funding, implementation began in 1997. The first description of TIES was presented at an International Conference in 1996 and can be viewed at http://www.atl.ualberta.ca/papers/change/tie.html/ and Appendix A. Note that all appendices can be viewed at http://www.quasar.ualberta.ca/edmedia/TIES/TIES_Report.html

Deliverables

The first deliverable is an outline of a Visioning workshop for Chief Academic Officers (CAO)s of an institution. This describes what will transpire in a workshop to create a vision for the institution (Appendix B). The second deliverable is a workshop outline for the training of TIES Leadership Task Forces (TLTF)s (Appendix C). The third deliverable is a set of TIES training modules in Web-Based Instruction (WBI) format. The list of modules is located in Appendix D. A sample module (L7: Dealing with Mental Models) has been provided in Appendix E. All modules are available at http://www.quasar.ualberta.ca/edmedia/TIES/Ties_home.html/

Project Planning and Implementation

Problems/Issues

The driving force behind TIES stems from the conviction that bringing people to actually change their practices with respect to new teaching approaches is extremely difficult. Critics of education, of which there is no short supply, often contend that:

- students are poorly prepared (for the work force),
- education has become bureaucratized, politicized and centralized,
- the current classroom-instructor based model and old learning theories are more consistent with preparing students for the industrial model of work, rather than for work in the information age,
- education is slow to change,
- school districts undertake innovation under circumstances of unclear goals, unpredictable technology, and uncertainty in general (Morris, 1997).

There are major advantages and disadvantages to Instructional Technology (Appendix F). The University has a rich history in computer-based instruction and the environment for Alternative Delivery Systems (ADS) there is described in Appendix G. Furthermore, ADS is an innovation. It cannot be understood or made to happen without a strong understanding of what an innovation is or is not. See Appendix H for pertinent findings from educational innovation.

Assumptions of TIES

Almost every system rests upon a set of assumptions which, if not met, may render the system inoperable before it begins. The assumptions of TIES are as follows.

- ADS is stimulated MORE by a strong vision, the willingness to share that vision, and an unequivocal commitment to that vision, THAN by policies and procedures (which should follow). Normal pressures for institutional reorganization, such as falling student numbers, competetion, and customer dissatifaction are not yet apparent in Alberta where expansion needs are being met using old models.
- Emphasis is placed FIRST on realistic goals of improving formal learning, such as increased achievement, decreased learning time, increased accessibility to instruction or cost control, and SECOND on the use of the technology of ADS.
- To succeed in reforming an institution, implementation of ADS must be widespread and pervasive throughout the institution and not confined to the small percentage of 'early adopters.'
- ADS requires ownership (commitment, not just compliance) by those who will ultimately implement it. This is the "Empowerment" phenomenon.
- ADS cannot be implemented in a shotgun approach. It must be strategically leveraged. This does not mean there is one correct model or plan--thus the emphasis on departmental teams making local decisions within the University.
- Implementation of ADS requires sacrifices at all levels of the institution. The sacrifices should not fall unevenly on specific groups or individuals. This was problematic in that the University of Alberta is currently recovering from a 21+% reduction in government funding.
- No one can predict the future, especially in the highly changing area of instructional technology. The best way to predict the future is to invent it though experimentation, keeping the good ideas and shelving those that don't work.
- The three sequential stages of innovation are play, use, and creativity. Support for and evaluation of ADS needs to be different for each of these three stages.

Phases

Phase I: Vision Building

The ultimate goal of Phase I is the creation, dissemination support building for a vision of what the instructional program of the institution will look like in the future; a vision generated by the Chief Academic Officers (CAOs).

A retreat involving the CAOs and key support staff who would be provided with stimuli, resources and a mechanism to capture and edit their deliberations was chosen (Appendix B). At the retreat, CAOs would be presented with examples of the use and impact of IT from within the institution as well as a sampling of the best practices from around the world.

Next comes a brainstorming session to create the University of Alberta Vision for Alternative Delivery Systems. The basic question to stimulate these outcomes is: "Suppose it is now 10 years into the future and your vision has succeeded beyond your wildest expectations. If you were to walk around the campus, city, and province, what evidence would you see of the success of this vision?"

Finally, discussion focuses on "What are the major barriers that stand between us and the accomplishing this vision?" This session encourages the CAOs to identify ways these barriers could be overcome. After a suitable time, it is expected that the CAOs publicly present the results of their deliberations with emphasis upon the vision and presenting a convincing case for their commitment to having it become a reality.

Phase II: Identification of Departments

Deans of faculties and chairs of departments were approached to describe the vision of the institution and the role of the TIES Leadership Task Force (TLTF) to meet that vision, and extend an invitation to participate. The authors identified six departments that appeared to be prepared to participate and in which there were active colleagues from previous work in ADS. One had other more pressing agenda items and declined to pursue the option further. Deans and Chairs were informed that the funding would provide $7,500 for each team and requested to provide additional resources in support of the work of each team.

Phase III: Development of TIES Workshop and Modules

The modules to be created had to provide basic instruction in ADS and change methodology, model ADS, and incorporate adult learning strategies (andragogy). The driving philosophy behind TIES is to make certain all TLTF members have a basic competence in the following areas of ADS: presentation and interactive digital technology, professional development, leadership, curriculum and instruction, evaluation, and related issues (See Appendix D) for a list of the 38 modules by topic.

In keeping with adult learning principles, it was recognized that 1) not all participants would need to study all the modules, 2) there was not enough workshop time to complete all modules needed by each individual, 3) some selection was needed by individuals, and 4) learning rates would require an allowance for self-pacing, all modules were developed in an individualized, self-paced web-delivered instructional format, complete with diagnostic and prescriptive self-assessment tools. The workshop also had the goal of building a team orientation to complete the workshop tasks and the activities of the coming year

Phase IV: TLTF Training

The workshop was conducted during a four day break in the second term of the academic year.

Phase V: Follow Up Support

TLTFs were informed that the training team would be available to assist in whatever way possible during the coming 12 month period. The support provides and models the importance of on-going, local and just-in-time support. A Web conference site was set up to facilitate communication within and between teams and trainers.

Evaluation Results

Phase I: Vision Building

Initially a retreat to develop a vision could not be scheduled. There was some difference of opinion as to whether the vision should be developed by the CAOs themselves (the author's opinion) or should be developed by key people in the university and presented to the CAOs for their approval.

During a retreat with CAOs, limited progress was made toward the goals of examining current noteworthy applications, creating a vision for the university, and identifying the key barriers and their solutions to making the vision happen. One key outcome was to begin a dialogue on the role of ADS with the deans of the university. Another outcome was the development of an updated version of the institution's technology integration plan (Learning First, 1998). However, this document and subsequent versions at the

University and Faculty levels do not possess the essential vision component. It appears that using a vision model does not mesh well with current adminstrative planning models.

Phase II: Identification of Departments

After extensive discussion and probing, five teams from across the university agreed to participate in the year long program, starting with an intensive workshop.

One Dean had begun work on a technology integration plan and invited the author to discuss TIES and asked to nominate a TLTF (TLTF B). Due to the small size of the departments in this faculty, they requested to participate as a faculty level team rather than as a department level team.

TLTF C was formed from an instructional technology team which had already been created and was grappling with how to proceed. Their plan was to convert a large undergraduate course to ADS-based instruction and use that to encourage departmental colleagues to become involved. This team had the most questions to ask about TIES and the author met with them repeatedly and answered numerous questions in person and electronically.

Discussion with another faculty resulted in the formation of TLTF D at the faculty level since the departments were quite small. The Dean was enthusiastic and involved a faculty member who was heavily involved in developing IT course materials.

When a presentation on TIES was made to the Associate Dean of another faculty, the enthusiasm was quite high and a meeting with the Dean was quickly arranged, followed by a presentation to the Dean's Council. TLTF E was formed from this faculty and once again, it was a faculty-wide endeavor as the departments involved are small and engage in many joint projects.

Due to the complexity of the TIES and its innovative nature (attempting to deal with change and reform rather than simply training or resources), an extensive schedule of meetings, discussion, writing, explanation, answering questions and negotiation had to be carried out

Phase III: Development of TIES Workshop and Modules

Content: The driving philosophy behind the TIES training program is to make sure all TLTF members attain a basic competency in several different areas of ADS and change. In the area of ADS, modules were designed to deal with digital presentation technology (7), digital interactive technology (5) and distance delivery (3).

In response to instructors' requirements to know how to apply IT to courses and curricula, a set of modules on curriculum and instruction (6) and evaluating students (4) were developed.

On the assumption that teaching bright, articulate, and motivated instructors to develop ADS is relatively easy but motivating people to change behaviors is considerably more complex, a series of eight modules designed to promote leadership skills aimed at resistors was developed. The content of the modules draws heavily from the work on change of Senge, Kotter, and Covey among others, and their writings were employed in the learning activities.

Finally, a series of 5 modules on key related topics (e.g., professional development, copyright, and effectiveness of IT) were created. These modules are open for viewing at the TIES web site listed at the end of this article.

Methodology to Acquire Content : Each module was designed to be completed in a self-paced format with several optional objectives and linked activities to choose from. Each module has its own self-assessment pre and posttest, the expected objectives, and learning activities to meet those objectives. In keeping with the team-building theme, several modules required completion by either the departmental team or a cross-team but small group. In order to make the instruction available on an extensive basis, i.e., beyond the workshop, the modules were created in a web-based instruction format. A diagnostic pretest, covering all 38 modules, was developed using the preassessment items from the modules

Methodology to Foster Team-Building : Professors may or may not have experience in substantial team efforts, in spite of the fact they may have worked together in the same department for substantial lengths of time. Activities were included which were aimed specifically at dealing with cooperative efforts with respect to providing leadership. These were couched in the context of ADS.

Phase IV: TLTF Training

The TLTF training took place during a 4 day school break in February 1998. The entire TLTF C participated, including the department chair and a faculty member who was officially on sabbatical leave. TLTF A, on the other hand, was a no-show. No one from the team participated and the chair did not offer the courtesy of contacting the workshop coordinators that they had decided not to participate, although one participant had indicated a conflict due to a conference scheduled the same time

TLTF B consisted of a single individual who had recently returned from his faculty from several years at another institution. This individual was well-versed in the WWW component of IT, keenly interested in the promoting IT in general and had strong support from the dean.

TLTF D did not translate the specified team structure into reality. It consisted of one full time faculty member who was actively developing a WBI course for the faculty, three part time sessional instructors, and no faculty administrators. TLTF E was also at the faculty level and consisted of a seasoned IT person, also just returned from a sabbatical leave, an Associate Dean, and a sessional instructor. They also participated in the entire workshop and began to develop ideas for working with their faculty colleagues.

During the six months following the training of TLTFs, the teams returned to their respective academic homes to 1) increase personal use of alternative delivery technology, 2) identify and meet training needs of colleagues in the home academic unit, 3) provide or arrange for support for colleagues in the unit and 4) develop a long range plan for the home academic unit which would begin to address the future direction and requirements for alternative delivery systems. The latter activity was particularly timely as the university administration, with stimulation from ADEM, requested a "Technology Integration Plan" from each Faculty.

Evaluation Results

TLTF "A"

It is not clear why this task force did not bother to attend the workshop or to inform workshop leaders of this decision. One member previously indicated inability to attend due to a conflict with a previously scheduled conference. Perhaps the lack of interest in ADS evidenced by the lack of a clear vision statement for ADS by either the university or the dean sent a signal. Perhaps a clear understanding of TIES and its goals and objectives was not conveyed to those involved.

TLTF "B"

Team "B" consisted of a single individual from a faculty whose Dean had previously and in several ways expressed a strong interest in ADS. They too chose to participate as a faculty rather than department due to small size. The individual participated extensively and expressed appreciation for the empowerment philosophy of TIES, having recently come from an environment where technology had been ruthlessly enforced on a faculty with major negative implications. After the workshop, the Dean reassigned this individual to a full time ADS coordinator who then formed an ADS team that embarked upon developing and implementing a long-range technology integration plan for the Faculty.

TLTF "C"

This team came the closest to meeting the TLTF selection criteria: several key opinion leaders, the department chair, and several members already active in ADS. Before agreeing to participate, they asked many important questions about the workshop and commitment expected. They participated actively during the workshop and by its end had developed the structure of a long range technology integration plan. At the time of this writing, the Project Director has not had the opportunity to interview the team for more specific details of their progress.

TLTF "D"

TLTF D was driven by a single individual, rather than a team. Steve (not his real name) identified a need for training his colleagues in the basic use of computers and contracted two individuals to create training materials in these areas which would meet the unique needs of this Faculty.

Steve personally conducted several two day workshops and provided personal support to colleagues. The major activity that consumed Steve's time, in addition to carrying an above average (for the University) teaching load, was the development of a web-based course.

The experience of TLTF D is highly representative of the individual entrepreneur approach to change (see Team Section of this report above). Note that no administrators or other faculty opinion leaders (beside Steve) participated in TIES training week. It might be concluded that the experience of TLTF D was solid, positive, but quite limited in the scope and depth of addressing alternative delivery systems in the unit. It depended upon the good will of Steve. However, Steve observed that his work in alternative delivery, particularly in the development of a web course was cited as a positive factor in his receipt of tenure.

TLTF "E"

TLTF "E" participated as a faculty, rather than as a department. Historically, this faculty had recently been reorganized through a merger of disparate departments that did not possess a great deal of affinity with one another. This task force came close to meeting the selection expectations, with an Associate Dean and several key opinion leaders. It also included several sessional instructors and research personnel. Their participation in the workshop was quite strong and they too began to develop their technology integration plan. Subsequent to the workshop, this team developed and submitted its TIP to the faculty as a whole, developed several successful ADS funding proposals, hired a course developer and hired an instructional designer. They have also begun discussions with other units on campus regarding joint professional development masters degrees to be delivered by ADS.

Lessons Learned or Revisited

- TIES is relatively successful in meeting its goals, given the limitation the several of its critical assumptions were not met.
- People are interested in quick and easy solutions to complex problems which involve change, reform, or different ways of operating.
- Communicating the requirements for change is extremely difficult, both in the reason change is needed and how change can be effectively implemented.
- The concept of making the necessary commitments to build internal expertise to provide leadership through a task force does not fit within the normal operational mandate of educational institutions. Task forces are rarely explicit about professional development, don't understand the need for commitment by senior leaders, and are often viewed as 'the solution' rather than as a means to the solution.
- The effects of the absence of a strong vision from chief academic officers and other administrators ADS appears to have been substantiated.
- The importance of the entrepreneur or keeper of the dream to the functioning of the TLTF has been substantiated.

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Webcasting the First U.S.-China Internet-Based Telemedicine Consultation

Michael Fuchs, Web Projects Manager,
Stanford University School of Medicine Information Technologies
<fuchs@stanford.edu>
<http://fuchs.stanford.edu/work/>

Abstract: On June 26-27, 1998, doctors at UCSF Stanford Health Care consulted via the Internet with pediatricians at Xi'an Medical University Hospital in Xi'an, China, on the cases of two critically ill children. Stanford Medical Information Technologies (medIT), in cooperation with Sun Microsystems and others, developed an architecture that allowed the doctors to use Internet video, audio, whiteboard, and browser applications to confer and review the medical cases; and to webcast the entire session across the Internet via RealMedia. Secretary of State Madeleine Albright and other ranking members of the Clinton Delegation to China attended the session.

Introduction

Background: Internet-based telemedicine, though in its early stages of development, is of great importance in less-developed countries, where advanced medical facilities and expertise are concentrated in major cities, and inaccessible to large segments of the population who reside in outlying areas. Telemedicine systems can allow practitioners in regional and rural hospitals and clinics to draw on the resources of major medical centers. Many hospitals in China, such as Peking Union Medical College Hospital, have acquired video-based teleconferencing systems and are delivering telemedical services. These services are far too expensive for the use of the average Chinese citizen. Internet-based consultation systems have been used to distribute telemedicine at extremely low cost. In the spring of 1995, the case of a patient with heavy metal poisoning was sent from Beijing to the U.S. Respondents around the world sent suggestions for treatment over the Internet by e-mail. However, text-based e-mail does not provide the capability for radiological imaging, transmission of sound files (such as the output of a stethoscope), and in particular the real-time direct interaction of medical colleagues, which is seen to be crucial in facilitating consultation. The Internet now holds the promise of providing this type of interaction at much lower cost than proprietary videoconferencing systems.

Goals of the Demonstration: The high-end telemedical technology systems that are being used in the U.S., U.K., and Israel, cannot be deployed widely in China, or operated on a routine, day-to-day basis. What are needed are low-end systems that match the capacities of existing network infrastructure and computers, such as the Internet-based applications that were demonstrated at Xi'an Medical University and UCSF Stanford during this demonstration. The challenge is to deliver benefits of modern medicine to locations that are last in line to receive them, using applications that will work reliably and on a day-to-day basis in the most difficult environments. Making use of the publicity surrounding the Clinton visit to China, it was hoped that a convincing demonstration of real-time Internet-based telemedical consultation (the first of its kind) would pave the way and lead to future advances.

The Event: On June 26-27, 1998, doctors at Xi'an Medical University (western China) and at UCSF Stanford Health Care (California, USA) participated in the first real-time medical consultation between China and the United States over the Internet, on behalf of two critically ill children. The demonstration, which coincided with President Clinton's visit to China, was designed to highlight U.S.-China cooperation in medicine and technology and underscore the role that telemedicine can play in improving patient care. The consultation used Internet technology, which allows for real-time communication and sharing of information, including images of the participants, photographs, medical records and other graphics, and voice communications. The nonprofit organization Bridge to Asia conceived and organized the demonstration, which was hosted by UCSF Stanford Health Care. The technology was installed and managed by Stanford medIT (in the U.S.), and engineers from XMU (in China), with support from Sun Microsystems.

Participants: In China, the event was presided over by Secretary of State Madeleine Albright and Secretary of Commerce William Daley, both of whom addressed the audiences in California and Xi'an with speeches praising the technological cooperation and emphasizing the importance of medical, educational, and cultural exchanges between the U.S. and China. "This is indeed a very impressive set-up and an impressive achievement, and as we inaugurate this link between Xi'an and The Stanford Medical Center, we use technology the way it should be used–to save and improve people's lives," said Albright. "It is a sign of how quickly the newest information technology is coming to China and how far reaching its effects will be."

The other U.S. dignitaries were Senators John D. Rockefeller, Daniel Akaka, and Max Baucus; and Representatives Edward J. Markey, John Dingell, and Lee Hamilton.

The UCSF/Stanford physicians providing the consultation were Dr. Daniel Bernstein, Chief of Pediatric Cardiology and Associate Professor of Pediatrics, Stanford; Dr. David Stevenson, Neonatologist, Stanford; Dr. Joseph Kitterman, Professor of Pediatrics and Neonatologist, UCSF; and Dr. David Teitel, Professor of Pediatrics and Chief of Pediatric Cardiology, UCSF. Said Dr. Teitel, on the subject of telemedicine, "I think it's clear that patients gain a tremendous amount when physicians are able to communicate and share critical diagnostic information and images in real time."

The Patients: The doctors discussed treatment for what had been diagnosed as viral myuocarditis, an inflammation of the muscular walls of the heart, in a 12-year-old girl who had been suffering from shortness of breath, fatigue, and abnormal heart rhythms. They also reviewed treatment for a male infant who was born by Cesarean section on June 13 and was suffering from brain damage due to a lack of oxygen and decreased blood flow at birth.

Technology and Architecture

Overview: There were two technological challenges to the telemedicine demonstration. One was facilitating the actual conference, with video, audio, shared whiteboard, and image viewers (for radiological images)–ideally using lightweight and widely available applications. The second was capturing all of the audio and video, digitizing it into RealMedia, and streaming it out live, so people world-wide could witness the event online. The final architecture was a bit complex, but very robust and functional. Two Sun workstations were installed on each end, running a suite of freeware Internet conferencing applications, browsers, image viewers, and supporting software. The full video output from one of the conference workstations was captured with a high-end scan converter and streamed into an onsite PC running Windows 95 and RealPublisher; this machine converted the video (and audio, captured from a conference phone) into RealMedia, which it streamed across the local network to another PC (in the next building) running RealServer. From there, the audio/video stream was sent out over the Internet. The video feed was also sent to a large display device in the U.S. conference room, for the edification of live participants as well as captured directly by the various camera crews in attendance for broadcast on news programs.

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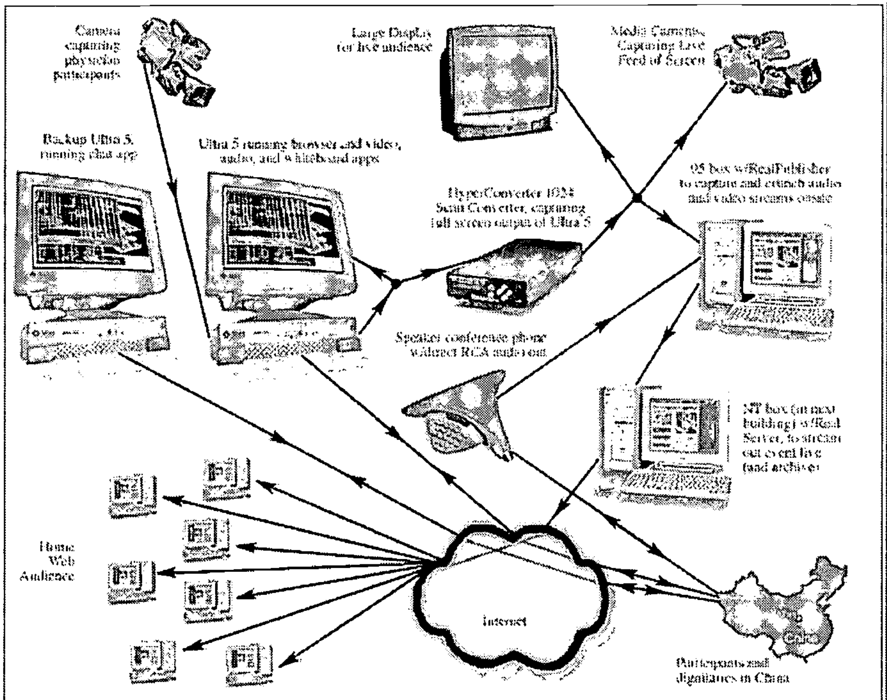

The Complete Architecture of the Setup on the U.S. End

Hardware & Software (for the videoconference): On each side, two Sun Ultra 5s (one with 24-bit graphics capability), both running SunOS 5.6, were utilized for the conferencing applications. Sun desktop cameras and microphones, as well as standard VHS video camcorders, were used for audio and video capture. The workstations on both ends ran a suite of TCP/IP conferencing applications from Berkeley Labs: vic (video), vat (audio), and wb (shared whiteboard space). [Documentation available at <http://www-nrg.ee.lbl.gov/>.] All machines ran the Sun HotJava web browser and the RealPlayer streaming media player from RealNetworks. Unix talk was utilized for some technical interchange.

Hardware & Software (for the webcast): A HyperConverter 1024 Scan Converter was used to capture the full video feed from the main conferencing workstation. [Information on this product available at <http://www.pcvideo.com/1280ds.htm>.] A high-end table-top conference phone, with direct RCA audio out, was ultimately brought in for the audio portion. (The TCP/IP-based audioconference link was judged too spotty (see below) for use in the actual event, and was supplanted by telephony.) A Windows 95 box onsite ran the RealPublisher 5.0 software to capture, and convert in real time, the audio and video streams. These streams were run across the LAN to a Windows NT server running RealServer 5.0, with a 100-stream license, and out to the Internet. A link to this RealMedia stream was provided on the official web site. [Information on RealPublisher and RealServer available at <http://www.real.com/>.]

Network: The machines on the Stanford end were connected via 10 megabit ethernet to the SUNet backbone, and through BBNPlanet to the Internet. In Xi'an, the machines were connected to CMINET (the Chinese Medical Information Network) to CERNNET (the principle backbone in China) to the Internet. Two satellite hops and a microwave link were involved in getting Internet traffic from the U.S. to Xi'an (in rural western China).

Hurdles

Infrastructure: One of the catch phrases of the event was was to show "the Internet in China as it is, not as we wish it to be." In numerous tests over a period of several weeks leading up to the event, attempts were made to secure, and make best use of, bandwidth into Xi'an Medical University. It was particularly critical to experience some success in our testing, as a number of the "dry run" sessions were attended (frequently without advance warning) by members of the U.S. State Department advance team; their impressions would dictate whether this consultation was included on the schedules of the visiting U.S. delegation. During one State Department visit, a camera went out; during another, one of the workstations in China crashed and wouldn't come back up. These situations were handled smoothly on a case-by-case basis. But, overall, experiences of limited bandwidth, packet loss, and low video frame rates were acute in numerous tests. Compression of the video was optimized, but it was ultimately decided that the spottiness of the audio stream would be too frustrating for the dignitaries, and (to a lesser extent) the physicians. As a result, we reluctantly decided to use a telephone conference call for the audio portion of the live event.

The total bandwidth into XMU was extremely limited, so some steps were taken in advance to address this. The microwave link from Xi'an to Beijing was overheating in the sun during the day, so the dish was upgraded a few days before the event. Preparations were also made to cut off all other Internet traffic from XMU during the period of the demonstration. Additionally, during testing the night before, we experienced interference in the video stream from China which was unrelated to the Internet transport. We determined that this was caused by on-off cycling of air conditioning units at XMU; consequently, people at XMU were cut off from their climate control (as well as the Internet) for a short time.

The Internet-based video, shared whiteboard, and shared image viewing eventually went over extremely well. Although video-taped welcomes and introductions were not shipped to China in time for the event, digitized RealMedia versions of these materials were transferred electronically, an unexpected coup for the Internet.

Architecture for the webcast: One of the main architectural challenges was how to capture various video sources (two conferencing windows, the whiteboard, images in a browser, etc.), as well as audio (complicated by the use of telephony), and convert it all into one audio/video stream for RealCasting. Several strategies were considered, but ultimately we concluded we had to pull the full video feed from the main workstation (on its way to the monitor). The HyperConverter 1024 scan converter, with its 13W3 Sun video connector, solved that problem for a relatively modest price ($1,395). The direct RCA audio out on the conference phone solved our problem of capturing both ends of the dialogue. The scan converter and the phone were both run directly to the PC running RealPublisher, resulting in a very good quality RealMedia stream.

U.S. vs. China: Time zone, language, and cultural differences were issues to be dealt with--but none proved serious. Most of the live tests were conducted in the evening on the U.S West Coast, to coincide with morning in Xi'an. The great majority of the Chinese technicians and physicians had a very good command of English--though on some occasions it was helpful to have a bilingual participant who was familiar with medical terminology (James Bair, the Director of International Medical Services for UCSF Stanford Health Care). Finally, the cultural differences were inconsequential, and the engineers definitely spoke the same language.

Results

On the evening of the event, introductory comments were made by Secretaries Albright and Daley, and the Internet link was established. The U.S. physicians consulted, in pairs, on the two different cases (neonatology and pediatric cardiology) for about two hours. They viewed CT and lung x-ray images in an image viewer and browser, asked questions, and provided opinions to their colleagues in China. They also exchanged e-mail addresses (using the whiteboard application) to facilitate follow-up.

Several multimedia materials (a welcome and introduction of the physicians, a video tour of pediatric facilities at UCSF/Stanford) were prepared but not used in the actual event (they are available on the site). The live webcast of the actual event was not ultimately approved by the People's Republic of China, or the U.S. State Department, a mildly disappointing turn of events. The initial consultation and preparatory session of the night before *was* successfully webcast, proving the viability of the architecture. But the main event, with the dignitaries, was blacked out from the Net, though not from traditional media.

The event received coverage from the New York Times, the L.A. Times, the San Jose Mercury News, the China Press, and Sing Tao Daily; as well as CNN International and San Francisco area local broadcast news.

The Main Screen of the Event. Counterclockwise from top left: the consulting physicians in the U.S.; a chest x-ray of the infant; a web browser with a screen from the official site; in China, Secretary of State Madeleine Albright using the system (assisted by Robert Yung, CTO Sun Microsystems Asia).

The Web Site

A complete informational site was created in conjunction with the event. Information, images, multimedia, and future plans continue to be available on the web at <http://telemed.stanford.edu/telemed/>.

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Becoming a Student in an Asynchronous, Computer-Mediated Classroom

Donald J. Winiecki, Ed.D.
Boise State University, College of Engineering
Department of Instructional & Performance Technology
1910 University Drive
Boise, Idaho 83725-2070 USA
dwiniecki@boisestate.edu

Abstract: Graduate instruction is traditionally delivered in face-to-face classrooms in university settings. However, with the decentralizing of corporations and workforces in the late 20th century, potential students have been distributed far from traditional academic centers. Distance education is a viable option for these persons. Asynchronous learning networks (ALNs) are an increasingly available option for distance education. However, ALN environments impose unusual constraints on the way individuals perceive themselves, their fellow students and their teacher, and how they interact as students and teachers. The transition from face-to-face classroom to ALN classroom is, therefore, tricky for students and teachers alike. This paper describes characteristics of competent students in a face to face classroom and then contrasts them with problems typically experienced by students in an ALN. Solutions for these problems are described and used to create a model of instruction for helping students become competent and collaborative learners in an ALN.

Introduction

Graduate instruction is traditionally delivered in face-to-face classrooms in university settings. However, with the decentralizing of corporations and workforces in the late 20th century, potential students have been distributed far from traditional academic centers. Faced with this situation, persons wishing to pursue continuing professional education have been forced to choose between employment and leaving a job to attend school full-time.
Distance education has emerged as a viable option for these students. Instead of moving to the education, a student can have educational opportunities sent to himself or herself. Students can enroll in courses, participate in them, and graduate with degrees without every actually "being with" their instructors or classmates.

Many delivery options exist for distance education. For example, correspondence courses, compressed video or satellite television and computer based asynchronous learning networks (ALNs) are common distance education delivery systems. ALNs have the advantage of permitting students to participate in educational experiences in a "time shifted" environment. In other words, because students and teacher are not required to meet at the same time, ALNs permit students from different time zones, and with different work schedules to interact in the same "classroom."

The skill of being a competent classroom student is a status and skill learned implicitly over many years of experience in traditional face·to face classrooms. However, ALNs impose unusual constraints on the way individuals perceive themselves, their fellow students and their teacher, and how they interact as students and teachers. The transition from face-to-face classroom instruction to ALN instruction is, therefore, tricky for students and teachers (Harasim, Hiltz, Teles & Turoff, 1995).

A Theoretical Model of the Competent Classroom Student

Hymes (1974) indicates that there are several skill-sets required for competent interaction. First is a mastery of the behavioral elements of interaction. Second is a mastery of the linguistic components of interaction, and third is skill at mixing the first two – knowing how to behave in interaction, and saying appropriate things at the right times. Hymes (ibid.) indicates that this third skill is what makes a person a functional and contributing member of a culture or community. However, before this skill may be practiced, the first and second elements must be mastered. Each of the three interaction skills is necessary for competent classroom interaction, but none is sufficient for competent classroom interaction.

Hymes' (ibid.) constructs are intended to describe competent members of interactive social communities. However, his three-part model is readily applicable to classroom settings – whether they are instantiated in traditional face-to-face classrooms, or asynchronous classrooms. This is especially true in highly interactive, or cooperative classrooms. Highly interactive classrooms are sometimes very desirable, for example in a design-based engineering classroom where ideas and technologies are discovered, tested and refined. In fact, Salomon (1993) and Schrage (1990) explicate that interactive or cooperative communities provide a richer environment in which to share and develop ideas and engage in learning, than do more didactic instructional environments. When members of a classroom possess and practice all three of Hymes constructs, cooperative learning communities can exist and thrive.

The Task of Becoming an Asynchronous Student

Problems. Distance education in general, and ALNs in particular permit access to educational opportunities to persons who might not otherwise have it. However, there are several roadblocks to competent classroom membership in the ALN classroom. The first can occur immediately upon entry to the distance education environment and is associated with using the technological tools of the distance classroom.

In the asynchronous classroom, students normally use some form of E-mail to send comments to classmates and the teacher, and to receive messages from them. If a student is unfamiliar with the particular communications tool being used in class, he or she lacks the first of Hymes' constructs. There is a paradox associated with this problem. In order to be a contributing member of the classroom, a student must have mastered the tools being used to interact, and the ways they may be used. However, the novice ALN student must know how to use the communication tools before interaction becomes possible.

The second roadblock is related to the first. It is not enough to simply "know how" to use the required communication technologies. The student must also know when to use these tools in a way that will facilitate the learning process. For example, a student may know how to send and receive classroom messages (fulfilling part of Hymes' first competency construct), but if he or she does nót know and practice the skill of filing messages in a way that facilitates retrieval (for example, by a keyword, or in a particular folder arrangement) – and then use their system to organize efficient study of the material, learning may not be accomplished.

The third roadblock to competent classroom membership effects the second of Hymes' interactive skills, mastery of the linguistic components of interaction. While most students attending a distance class will be capable speakers of the language used in class (for example, spoken and written English), speaking and writing in the distance classroom is subtly, but importantly, different then what is familiar in a face to face classroom. For example, in a traditional face to face classroom, interactants make use of many non-language signals to create messages and to interpret and understand what is going on. For example, voice inflections, facial expressions, hand motions, linguistic devices (for example, sarcasm), etc., are used by speakers to embellish their messages. Once these paralinguistic devices are known and understood, they also assist listeners in understanding the message as intended. However, because the primary communication channel in the asynchronous classroom is written text, none of these para-linguistic devices may be used in their conventional form. However, because they are so common in face to face classroom interaction, it is very common for novice asynchronous students to use sarcasm, a cliché, or "insider knowledge," to embellish a written comment. However, without the benefit of familiar paralinguistic signals, these comments are often misunderstood – and may result in unintentional insult or embarrassment. Together, these three roadblocks may create an incorrigible problem for students in an asynchronous classroom. Therefore, interactive learning communities may never develop.

Solutions. It has been observed, however, that when the instructor and students foster an open and interdependent exchange of instructional and social dialog in the asynchronous distance education classroom, students can simultaneously overcome both of these roadblocks (Winiecki, 1997). This process is similar to that described by Wittgenstein's "language games" (1958). Sociolinguists have argued that language games facilitate the development of pidgin languages and eventually permit individuals with vastly different backgrounds and languages to develop a mutually acceptable language. "Language games" are characterized by episodes of showing what is being spoken of, speaking of it, and negotiating understanding of a task that involves it, at the same time. The goal is to communicate not only the concepts being discussed, but also to negotiate a mutually understandable and acceptable way of communicating about it, at the same time.

For example, the following conversation occurred between two, first-semester graduate students in the ALN course, "Introduction to Instructional & Performance Technology," offered the Instructional & Performance Technology department of Boise State University's College of Engineering.

[start of transcript segment]

Rebecca (9/28/97, 9:20PM): I can't find last week's assignment! I remember reading it, but now

Instructor (9/29/97, 8:15AM): Hi Becky. You should be able to find it in your database of messages. Go into your database, and search for all messages sent on September 22nd. It will be easy to pick out of that list.

Rebecca (9/30/97, 6:23PM): What database! I don't have any database – all I see is a bunch of messages from everyone to everyone!! Nobody seems to be talking about the same thing!!! This is very confusing!!!!

George (9/30/97, 7:44PM): Hey Rebecca, did you follow the setup instructions in the computer conferencing guide? It's really easy and it tells you all about creating and using your messages database.

Rebecca (9/30/97, 8:03PM): It might be easy for you!!!!! I tried to follow those instructions but I can't understand them – I must not be computer literate enough to understand it all. Will you send me the assignment?!

Instructor (10/01/97, 8:27AM): Hi Becky, I'll send you the assignment again, but we've got to get your messages database set up. Try this: From the "message packets" screen, click the "Import" button, and then answer "Yes" when the software asks you if you "want to import all messages." The software will then build your messages database (you'll see a scrolling list of every message you've ever received, as it is inserted into the database). When it's done you'll see a new icon titled "Messages database." You'll be able to search through this to find any message.

Rebecca (10/01/97, 7:10PM): Thanks for your help, but how do I know which screen is the "message packets" screen?!

George (10/02/97, 8:44AM): Oh, sorry about that... The "message packets" screen is the one with the gray background, and has a list of many message "packets" in a blue rectangle.

Rebecca (10/02/97, 7:37PM): Hey! I just did it – and now I've got a messages database. Should I keep all of the other files that are listed on this "message packets" screen?

George (10/03/97, 8:48PM): Super! It's a real feeling of accomplishment when you prove to your computer who's boss – isn't it!? I remember when I got my first BASIC program to run. I felt like jumping up and "high-fiving" everybody!

Rebecca (10/03/97, 9:15PM): Hey! You must be some kind of computer expert – writing programs and all! ...

[end of transcript segment]

In this interchange, Rebecca was unable to understand the language contained in a booklet that described how to perform some task in the communications software. Another student and the instructor attempted to communicate with her but found that she was not able to interpret their language either. George then engaged in a "language game" with her (shown as boldface in the transcript, above) complete with descriptive references to the software screens and how she should proceed. This language game was used between the students to negotiate what "database," and "message packets screen" meant before they could actually solve Rebecca's problem.

Rebecca's inability to solve the problem is not unusual. There are as many "Rebecca" students as there are "George" students. Technical documentation is not enough to support all ALN students. Occasionally, it is necessary to engage in an interactive "language game" to find out what is not understood, and how to solve the problem. In some instances telephone calls between students or between the instructor and students are necessary, to work beyond problems – especially if the difficulties prevent asynchronous interactions.

Ability to control communications software is only a small part of interacting and learning in an ALN. Hymes reminds us that it is also necessary to know how to communicate to other learners. Students in an ALN classroom are very familiar with classroom interactions – they have all been students in conventional, face-to-face classrooms in the past. However, "talking" in an asynchronous classroom as if it were a face-to-face classroom can lead to unexpected results, as can be seen in the following transcript.

[start of transcript segment]

Anna (10/12/97, 9:08PM): Hey, Wanda – old girl! How did your performance appraisal interview go at work yesterday?

Wanda (10/14/97, 7:23PM): Anna, I know we've been working on a group project this week, but I don't know how to understand your comment from last Sunday. Have I been too slow to finish my part of the project?

Anna (10/14/97, 8:10PM): Wanda, I had to go back to my message from Sunday to find out what I said. I apologize, I didn't mean to imply that you're moving slowly on the project (or anything for that matter). I was just teasing a little bit because we seem to be doing so well as a group.

[end of transcript segment]

In this dialog, Anna appears to have been offended by Wanda referring to her as "old girl!" After these comments, Anna and Wanda appeared to remain somewhat uncomfortable with each other and their groupwork and classroom interaction suffered. A telephone interview by the researcher, with both Anna and Wanda disclosed that this incident was troubling to both of them, and that neither was able to "forget about it." However, following this experience, both Wanda and Anna reported that they were much more careful about how they worded messages to classmates.

Nevertheless, sometimes it will facilitate interaction if the "speaker" and "listeners" in an ALN are able to discern the attitude with which a certain comment is being voiced. For example, sarcasm and hyperbole are important linguistic mechanisms with which to highlight misperceptions in a Socratic dialog. In some situations, comedy relief can be used to change the course of a discussion or to defuse tensions in a prolonged discourse. However, as displayed above, all of these linguistic techniques are easily misunderstood if the "listeners" are not savvy to the "speaker's" intention. On the other hand, these techniques lose their impact if the speaker is too obvious in "telegraphing" his or her plan.

Interactants in online "chat" groups, MOOs, and MUDS (multiplayer, computer-based role playing games) have developed a technique that increases the possibility that these linguistic techniques will be recognized appropriately, but that does not reduce their potential impact. This technique is called "emoting" and is accomplished by embedding posture or attitudinal information in a message (Turkle, 1995). Similar techniques have been called "embodied actions" by other researchers (Jarmon, 1995).

For example, to display embarrassment, and a childhood innocence, a message sender might write:

<Don looks at his feet, and toes the sand> Gosh...

To display an almost fanatical devotion to an idea being discussed, the researcher once typed the following message:

<Don stands on his desk, faces East, thrusts his right fist into the air and shouts> Long live B. F. Skinner!

To exhibit approval for a student's effort, but also to encourage him to press on despite persistent difficulties, the researcher once wrote:

<Don emerges from a mist, and whispers in a solemn voice> use the force, Aaron.

Interestingly, the technique of "emoting" was spontaneously adopted by several of the researcher's students in their own messaging. Through telephone interviews with these students, I learned that my "emoting" comments elicited laughter, reflection and surprise – but in all cases, the students described that the use of "emotes" led to a much faster, and deeper understanding of the comment than they felt could have been realized otherwise.

Serendipitous Side Effects

The social processes and the cooperative development of technical skills and communication techniques described above has also had the serendipitous side effect of engendering a cooperative and interdependent learning culture among students (Winiecki, 1997). Soon after the emergence of "language games" and "emoting," students increased their mutual problem solving and help seeking activities. They became much less reliant on the teacher as a source of answers, and more reliant on each other and their individual areas of expertise, as the following set of messages displays.

[start of transcript segment]

Rebecca (11/12/97, 12:14AM): George, I haven't been able to figure out what Gagne is talking about in chapter 4. Have you been able to make sense of it?

George (11/13/97, 7:18PM): Hi Becky, I've been away on a business trip and haven't had time to reread the chapter. But if I remember correctly, he was trying to classify the different kinds of things that people usually have to learn. I understood verbal, psychomotor and concrete concepts, but I don't think I really know what he means by defined concepts or rules. Is this where you're getting stuck also?

Rebecca (11/13/97, 7:45PM): Yes, George, I'm "not getting" what he means by "defined concept." Every time I think that I understand, I go back and read pages 59 – 61 and I start doubting myself again.

Aaron (11/13/97, 8:27PM): Rebecca and George, I think I've got an example of the difference between a concrete concept and a defined concept...

George (11/13/97, 8:36PM): Hi Aaron. Your example got me thinking. Do you suppose that ...

Rebecca (11/13/97, 9:17PM): Hmmm <rebecca scratches her head, and looks confused>, I'm still not sure – but I think that I'm getting closer to knowing what this stuff means. I don't know what I'd do without you guys. Here it is almost 9:30 on a Thursday night and we're still working on this stuff. Do you think we'll figure it out before the test next week?

[end of transcript segment]

Aaron, George and Rebecca appeared to be the most active cohort in the class. Their interactions spanned both curricular and personal matters. On several occasions, Rebecca referred to future interactions with her classmates. For example, as the semester neared its end, she sent a message to the class: "when we graduate, we're going to have to have a big party together!"

Since the semester when these transcripts were captured, Rebecca, Aaron and George have not taken another ALN course together. However, they still correspond in a public area of the ALN, called (aptly enough), the "Student Union." Their messages still refer to their experiences as classmates and they still task about taking other courses together. The experiences they shared were instrumental in facilitating an ongoing, and an interdependent learning relationship.

Conclusion

This paper describes tacit practices that are necessary for the successful accomplishment of "competent studentship" in a face-to-face classroom. It then described how these same practices are sometimes difficult to realize in asynchronous learning networks (ALNs). Finally, methods for aiding the ALN student to accomplish these tacit practices are described, and examples were given. While the concepts and techniques described in this paper are remarkably "unremarkable," their mundane appearance belies their importance in educational interactions.

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The Effects of Expert Stories on Sixth Grade Students' Achievement and Problem Solving in Hypermedia-supported Authentic Learning Environments(HALE)

Douglas C. Williams, University of Texas at Austin, Department of Curriculum & Instruction, USA, dcw@mail.utexas.edu

Abstract: An issue concerning school-based learning is the difficulty many students experience in applying what they have learned to everyday situations. Authentic learning environments such as problem-based learning have been proposed as a way to provide students an opportunity to engage in authentic activities in authentic contexts. This research study examines the effects of expert stories on students' achievement and problem solving. Two sixth grade science classes were randomly assigned to the treatment conditions in which the learning environment provided support in the form of expert stories or expert non-stories. Measures of factual knowledge recall, near and far transfer were administered. On the measure of factual knowledge recall, no significant difference was found between the story and non-story conditions. However, when asked to solve near transfer and far transfer problems, students in the story treatment did significantly better than students in the non-story condition. This finding suggests that expert stories can scaffold student learning. In particular, it appears that expert stories may help students transfer learning to novel situations.

1. Research Framework

An issue concerning school-based learning is the difficulty many students experience in applying what they have learned in school to everyday situations. Many schools are concerned with the transfer of abstract, decontextualized concepts (Brown, Collins, & Duguid 1989). Increasing amounts of research indicate that the inability of students to apply concepts learned in formal contexts is due to the abstraction and decontextualization of learning (Cognition and Technology Group at Vanderbilt 1992). Spiro and Jehng (Spiro & Jehng 1990) argue that the decontextualization of knowledge creates inflexible understandings. But it is not the abstraction of knowledge as such that distracts learners, but that the abstractions are not illuminated with examples in context. Understanding is a product of the context and activity (McLellan 1993).

Context provides a framework which guides and supports the learner. The context naturally structures knowledge in a way that suggests its proper use. Traditional instructional design attempts to simplify learning by dividing the content into components and teaching them separately. This reductionsist approach most likely will result in students resorting to rote memorization rather than engaging in meaningful learning. In contrast, situated cognition argues that learning is simplified by embedding concepts in the context in which they will be used (Brown & Duguid 1993). The context provides the much-needed support when working at the edge of one's ability. Yet authentic context alone is not enough to support student learning. Situated cognition argues that learners must engage in authentic tasks as well (Winn 1993). Authentic activities are the ordinary practices of the experts in that domain (Brown et al. 1989). The learning activity is an integral part of what is learned. One activity in which all domains engage is the solving of problems. Experts utilize tools to support problem-solving in context. Active use of a culture's tools provide learners the opportunity to view knowledge from the experts' perspective (Brown et al. 1989). Active learning in the context of a domain's culture allows the gradual "fleshing out" of concepts over time.

There has been a growing body of research on authentic and situated learning environments utilizing the problem-based approach to learning (Spiro & Jehng 1990). Problem-based learning (PBL) emphasizes solving authentic problems in authentic contexts. It is an approach where students are given a problem, replete with all the complexities typically found in real world situations, and work collaboratively to develop a solution. Problem-based learning provides students an opportunity to develop skills in problem definition and problem solving, to reflect on their own learning, and develop a deep understanding of the content domain (Lajoie 1993) (Jacobson & Spiro 1995). This approach was developed in the fifties for medical education, and has since been used in various subject areas such as business, law, education, architecture and engineering. Most recently, there is a growing interest among educators to use problem-based learning in the K-12 setting, and a growing need for problem-based educational software to facilitate the development of higher order thinking skills via technology.

Though literature supports the efficacy of problem-based learning environments, little research exists which investigates the types of tools or features that are effective in supporting students working in PBL environments. Many researchers have found that providing tools for students to use while working in a learning environment can result in positive learning outcomes (Lajoie 1993).

With an increased awareness of the efficacy of learning in context, there is a renewed interest in the use of stories as an information resource (Bell, Gold, & Kaplan 1998) (Burke 1993). Students are familiar with the narrative format, therefore stories are a useful vehicle for providing information (Edelson 1993). Stories are usually memorable since they provide rich detail within a specific context (Schank 1990). Stories of an expert's experiences can provide valuable insight into the application of knowledge in varied contexts (Danzig 1997). These stories can also provide a considerable amount of information about the teller's beliefs (Burke). All of these factors indicate that stories may be a useful mechanism for providing information to students when engaging in authentic problem solving.

In order to design an effective computer-supported PBL learning environment, it is important to understand how student learning can be supported. It is, therefore, the purpose of this study to examine how the use of first person narratives related by experts affect student learning while immersed in a problem-based learning environment.

2. Research Questions

This study investigates the effects of expert stories on middle school students' learning of science concepts. Specifically, the study asked the following questions: (1) How do expert stories affect students' acquisition of astronomy concepts? and (2) How do expert stories affect students' ability to transfer learning?

3. Design of Study

3.1 Sample

The participants of the study (N = 101) were students enrolled in sixth grade science at a middle school located in a medium-sized city in the southwestern United States. Four intact classes participated in the study. The participants in the study consisted of 73% white, 17% Hispanic American, 7% African American, and 2% Asian American students. The age of the students ranged from 12 - 14 years. There were approximately an equal number of male and female students.

3.2 Treatment

For this research, a hypermedia-supported authentic learning environment (HALE) was developed in the content area of astronomy. The learning goals of the HALE were for students to be able to:

- Plan and implement procedures for solving complex problems
- Identify relevant information needed in solving a complex problem
- Identify the characteristics of objects in our solar system

- Describe components that comprise probes used for astronomical research
- Rationalize the design of a probe in regards to it's intended mission
- Analyze data and draw conclusions from astronomical data

Two versions of the HALE were developed corresponding to the two treatment conditions: stories and non-stories. All versions of the program contain the same content and tools differing only in the implementation of the information provided by the expert tool. The *Stories* version has an expert tool containing short first person narratives (video) related by an expert. The *Non-stories* version provides the same content as the *Stories* version, except the expert relates factual information with no story elements.

3.3 Dependent Measures

Of primary interest in this study is how expert stories affect student learning. Therefore, measures of knowledge recall and transfer were administered. In addition to knowledge recall and transfer measures, interviews were conducted with the participants and the classroom teacher. The triangulation of the quantitative and qualitative data sources will help to answer the research questions with richer and more detailed information.

3.3.1 Recall Measure

The recall measure evaluated the amount of declarative knowledge students have concerning the astronomy concepts being taught in the study. The measure consists of multiple choice and fill-in-the-blank items. A panel of reviewers were asked to verify the validity of the measure. Items were revised until agreement was reached. The recall instrument was administered as a pretest, posttest, and retention measure. Due to the factual and objective nature of the measure, it was scored by the principal investigator. The recall measure was used to gauge the degree to which students acquire an understanding of astronomy.

3.3.2 Transfer Measures

As noted in the literature review section, students are often unable to apply what they have learned in problem solving situations. The review of literature put forth that this is due to the decontextulization of learning. Therefore, in order to evaluate student learning it is not sufficient to only measure acquisition of concepts. But one must also measure the ability to apply that knowledge in context. Hence, near and far transfer measures have been included in the design of this research.

3.3.2.1 Description of Near Transfer Measure

In order to evaluate to what degree students are able to apply their knowledge in solving problems similar to the one received in the treatment, participants were given a scenario in textual form describing a problem similar to the one received during the study. The near transfer measure was given as a posttest and used to provide information on the effects of the expert stories on student learning. After reading the problem scenario, participants were asked to provide the following information:

1. Hypothesis of a solution to the problem.
2. Rationale for hypothesis which includes supporting information learned while using the environment.
3. Indication of other information that would need to be gathered to support the answer.
4. Description of which scientific tools could be used to gather information to test the hypothesis.

3.3.2.2 Description of Far Transfer Measure

In order to evaluate to what degree students are able to apply their knowledge in solving problems that they have not encountered before, students were asked to solve a problem unlike those encountered during the treatment. The far transfer measure was given as a posttest and used to gauge the degree to which students are able to apply what they have learned to a novel situation. After reading the problem scenario, participants were asked to provide the following information:

1. Hypothesis of a solution to the problem.
2. Rationale for hypothesis which includes supporting information learned while using the learning environment.
3. Indication of other information that would need to be gathered to test/support the hypothesis.
4. Description of which scientific tools could be used to gather information to test/support the hypothesis

3.3.2.3 Scoring of Near and Far Transfer Measures

Since scoring the near and far transfer measures is subjective in nature, responses from the near and far transfer measures were evaluated by three trained graders who will be blind to the subjects' treatment conditions. Due to the large number of responses to evaluate, the responses will be randomly divided between the three graders. In order to ensure interrater reliability, each grader was given an additional 20% of the essays from each of the other two graders. These additional essays were randomly selected, scored, and compared with the scores from all graders. Each essay was scored in the following manner:

1. A score from 0 to 15 was given for the essay on the following criteria: (a) Quality/plausibility of the hypothesis and supporting rationale, (b) Level of incorporation of details and facts in the essay, (c) Thoroughness of analysis of needed information to support answer, (d) Number of tools cited and the appropriate use of them, (e) overall originality of ideas, (f) overall quality of the essay.
2. Scores from each of the criteria were collapsed into one overall score for the response.

3.4 Procedures

Four intact classes were randomly assigned to either the *Stories* condition or the *Non-stories* condition resulting in two classes in each. Because the treatment was included as a part of the regular science class, complete random assignment was not possible in this case. The assignment resulted in 49 students in the *Stories* condition and 52 students in the *Non-stories* condition. Within each class, students worked in heterogeneous groups of 3-4 students created by the classroom teacher. Students were presented with information about the nature of the learning environment. They were informed that at the end of the activity they would be asked for input concerning the aspects of the environment they found useful and those they did not. Prior to treatment, students were asked to complete the recall measure. After all groups had completed the activity, participants were asked to complete the recall measure, near transfer measure, and far transfer measure. Three weeks after the completion of the study, the recall measure was administered once again to all of the participants to collect retention data.

4. Analysis, Results and Discussion

In order to examine the effects of expert stories on students' declarative knowledge (research question one), a simple ANOVA with repeated measure was conducted using the data collection points pre, post, and retention on the factual knowledge measure with the treatment conditions as factors. The results show there was no significant effect for data collection point on achievement from pre-treatment to post-treatment to retention when considering the interaction between the treatment condition and the measure: $F(2,94) = 1.34$, $p = .266$ (STORY MEAN $_{pre}$ = 6.96; STORY MEAN $_{post}$ = 8.22; STORY MEAN $_{retention}$ = 7.87; NON-STORY MEAN $_{pre}$ = 5.96; NON-STORY MEAN $_{post}$ = 7.27; NON-STORY MEAN $_{retention}$ = 8.12). That is, students who received expert stories performed similarly to students who received expert non-stories on the measure of factual knowledge.

The unexpected lack of a significant difference between the story and non-story treatment conditions may be attributed to a number of factors. The HALE used for this research had many features to support student learning. The only apparent variation between the two treatment conditions was that the story treatment received expert support in the form of stories while the non-story condition received the same information, but in a format that was not a story. Since the environment was designed with many features to support authentic context and activity, the additional support provided by expert stories may not have been strong enough to make a difference in student's declarative knowledge. Especially since both treatments conditions received the support "just-in-time". In other words, other features in the learning environment may have supported students in the non-story condition. Similarly, stories and non-stories provide the same factual information differing only in the presentation. Therefore, acquisition of factual knowledge may not have been influenced since the factual content was equivalent in the two treatment conditions.

In order to measure the effects of expert stories on near transfer (research question two), a simple ANOVA was calculated with story/non-story conditions as a between-subjects independent variable and the near transfer measure as the dependent variable (post-treatment only). The results indicate there was a significant difference between the treatment groups: $F(1,52) = 6.37$, $p = .015$ ($MEAN_{story} = 10.6$; $MEAN_{non\text{-}story} = 6.9$). That is to say, students who received the expert stories performed significantly better in solving a near transfer problem than students which received non-stories. In order to explore the effects of the expert stories on far transfer (research question two), a simple ANOVA was calculated with story/non-story conditions as a between-subjects independent variable and the far transfer measure as the dependent variable. The results show a significant difference between the story and non-story treatments: $F(1,52) = 4.6$, $p = .037$ ($MEAN_{story} = 7.8$; $MEAN_{non\text{-}story} = 6.1$). In other words, students who received the expert stories performed significantly better in solving a far transfer problem than students who received non-stories.

These findings support the hypothesized benefits of situated cognition in a number of respects. Recall that situated cognition argues that it is essential that learning occur in an authentic context, that students engage in authentic activities, and that students learn about the culture of the knowledge domain (Brown, Collins, Duguid 1989) (Choi & Hannafin 1995) (McLellan 1993). The ability of students to solve complex problems is often cited as one of the most important goals of education. However, traditional methods of teaching often fall short of this elusive goal. Students frequently have difficulty solving such problems and often need support. This research hypothesized that expert stories might help scaffold student problem solving. Data collected for this research indicate that students who received expert stories did significantly better on solving near and far transfer problems than students who received the same information but not in story form.

It can be argued that stories can help provide a meaningful context for student learning through the rich detail included in them. Stories are also capable of illustrating knowledge in context, hence making learning more meaningful. It appears that the authentic context supported by expert stories can facilitate students' ability to transfer learning to new situations. Research by the Cognition and Technology Group (Cognition and Technology Group at Vanderbilt 1992) supports this finding that providing an interesting relevant context for problem solving can facilitate transfer to new problem solving situations. Other implementations of learning environments which emphasize the importance of providing a rich context for problem solving such as Schank's goal-based scenarios (Schank & Edelson 1990) and Spiro's cognitive-flexibility hypertexts (Spiro & Jehng 1990) (Jacobson & Spiro 1995) further support this finding.

Stories can also support student engagement in authentic activities. Scientists often share information in the form of stories. The listening to stories is itself an authentic activity. Mentors often share stories with apprentices in order to illustrate some point. Both theory and practice can be shown by the use of expert stories (Danzig 1997). Hence, the stories help students engage in authentic activities thereby facilitating better performance on problem solving. Research on anchored instruction and problem-based learning support this finding that engaging in authentic activities can facilitate transfer of learning to new problem solving situations (Cognition and Technology Group at Vanderbilt 1992).

4. Conclusions

As problem-based learning becomes more popular, instructional designers must find new ways to utilize technology in order to support problem-based learning. For this research an innovative problem-based learning environment was created which provided the context for learning and authentic activities for students to engage. Just as a mentor provides stories to an apprentice while working in context, this software attempted to provide stories to students as they were working. Constructivism and situated cognition provide a useful framework for realizing that it is not enough to rely on the affordances of media, but that the media must be utilized to facilitate the engagement of students in meaningful activities. In order to make learning meaningful, students should be placed in learning situations which allow them to engage in the same types of activities experts would in a context that is rich and interesting. Hypermedia-supported authentic learning environments (HALE) can be designed to accomplish this goal. HALEs bring together the valuable elements of hypermedia (i.e. audio, video, animation, non-linear access to information) and problem-based learning environments (authentic context and authentic activities) to create rich contexts for learning.

The confluence of hypermedia technology, constructivism, situated cognition, and problem-based learning provide an opportunity for instructional designers to create authentic learning environments. Hypermedia-supported authentic learning environments can extend beyond the school walls by providing a series of authentic experiences which can direct students along the path of life-long learning (Dewey 1938).

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Combining Social Networks and Collaborative Learning in Distributed Organizations

Hiroaki OGATA and Yoneo YANO
Department of Information Science and Intelligent Systems
Faculty of Engineering, Tokushima University, Japan
E-mail: {ogata, yano}@is.tokushima-u.ac.jp
URL: http://www-yano.is.tokushima-u.ac.jp/ogata/

Abstract: The exploration of social networks is essential to find capable collaborators who can help problem-solving and to augment cooperation between users. This paper describes PeCo-Mediator-II for seeking for a collaborator with the chain of personal connections (PeCo) in distributed organizations. Moreover, this system helps gathering, exploring, and visualizing social networks. The experimental results show that the system facilitates that learners encounter collaborators and develop a new helpful relationship beyond the classroom.

Introduction

Recently, opportunities for communication and collaboration via computer networks have immensely been increased in networked organizations (Sproull and Kiesler, 1991). A fundamental problem is how to encounter people who can help problem-solving. We are focusing on the problem of discovering such people through social networks. Social networks are at least as important as the official organizational structures for tasks ranging from immediate, local problem solving (e.g., fixing a piece of equipment), to primary work functions, such as creating collaborative groups (Kautz et al., 1997).

In CSCW (Computer Supported Cooperative Work), researchers are interested in the role of social networks between organizational members. Clement stated that users developed informal collaborative networks to know how to use a new software (Clement, 1990). Then, private networks are important for workers to solve problems by providing helpful information. A number of studies have shown that one of the most effective channels for gathering information and expertise within on an organization is its informal networks of collaborators, colleagues and friends. The networks of helping relationships are called "*Help Network*"(Eveland et al., 1994). However, the networks are not collected and generally follow work group alignments rather than technical specialization. Therefore, it is significant to use members' interpersonal connections effectively in their activities.

In CSCL (Computer Supported Collaborative Learning), one common component of collaborative learning is the "*informal peer-help networks*". This notion is compatible with Wenger's communities of learners (Wenger, 1996), where people who share learning goals within an authentic learning environment can develop ties that reinforce learning outcomes. From this viewpoint, Greer et al. (1998) proposed PHelpS (Peer Help System) that supports workers as they perform their tasks, offers assistance in finding peer helpers when required, and mediates communication on task-related topics. On the other hand, our approach focuses on how a system can support both storing and exploring "*Personal Connection*" (***PeCo***) in a collaborative learning environment.

W propose PeCo-Mediator-II (Ogata et al., 1996a; Ogata et al., 1998) for gathering, seeking, and visualizing social networks in a networked organization. PeCo-Mediator-II is a distributed system with a personal database (PeCo-Collector) and a software agent (PeCo-Agent). Every user has the two softwares on the respective site. PeCo-Collector incrementally gathers information on its user's acquaintances and the relationships through watching the exchanges of e-mail. PeCo-Agent moves to colleagues' sites and negotiates with other agents and users to find collaborators. Although the users of both NetNews and e-mail lists are passive to find answers, our system can actively discover collaborators with the chain of personal connection from the user and the collaborators.

Overview of PeCo-Mediator-II

Our initial system called PeCo-Mediator (Ogata et al., 1995) is a groupware that allows sharing of PeCo in a group and to search for connections between the user and targets. The users need to share PeCo with the common database of PeCo-Mediator. Although the system was very available in some small groups, it was reluctant in terms of users offering their private information like PeCo into the common database. Also, it is hard for the users to entry personal data of their friends.

When a computer network connects people or organizations, it is a social network. Just as a computer network is a set of machines connected by a set of cables, a social network is a set of people connected by a set of social relationships, such as friendship, co-working, or information exchange (Garton et al., 1997). Computer Mediated Communication (CMC) systems also reduce the transaction costs of initiating and maintaining interpersonal ties (Pickering and King, 1992). Weak ties created by CMC expand the channels of information sources for the individual and have potential for strong ties.

PeCo-Mediator-II is combined PeCo-Mediator and on-line social networks. It consists of the two systems; PeCo-Collector and PeCo-Agent (see Figure 1). Every organizational member has the two softwares on the respective site. PeCo-Collector gathers information on its user's acquaintances and the relationships through watching the exchanges of e-mail. PeCo-Agent moves between members' sites to find a partner in the community. The user's PeCo is a starting point for the exploration. The user's acquaintance acts as a liaison between the user and the partner in this situation. In this figure, user X requests user Y to help the problem solving, and user Y introduces user Z. After that, user Z can help user X by request.

The characteristics of this system are:

1) Accumulation of on-line and off-line social networks: Mainly, our system deals with PeCo based on the exchange of e-mail. PeCo-Mediator-II automatically stores relationships based on e-mail tags (Ogata et al., 1996). In addition, the user can provide on-line relationships; e.g., based on the exchange of name-cards.
2) Measurement of PeCo strength: The strength of PeCo is estimated with the frequency of e-mail exchange. This degree is very useful for deciding the receivers of the request (Ogata et al., 1996).
3) Privacy protection: PeCo-Mediator-II manages individual ties with a distributed personal database in the user's own site. Personal data is safer in a personal database than in a common database. Therefore, it is easy for this system to protect user's privacy and to be accepted in a large-scale organization.
4) Compatibility: The architecture of PeCo-Mediator-II is compatible with existing e-mail mechanisms. Compatibility reduces user overhead in taking advantage of the e-mail tools.
5) Scalability: Even if the number of users increase, this system can work robustly because of an agent based distributed system architecture.
6) Parallel exploration assisted by agents: PeCo-Agent supports the user to search for a collaborator through social networks while negotiating with other users and PeCo-Agents. Moreover, the user can visually understand the current status of the exploration and easily control that process.
7) Mitigation of collaborators' overload: The questions are possibly concentrated on a part of users (experts). This system provides a common database of answers and navigates the questions with strategies on educating the secondary collaborators and on spreading the answers.

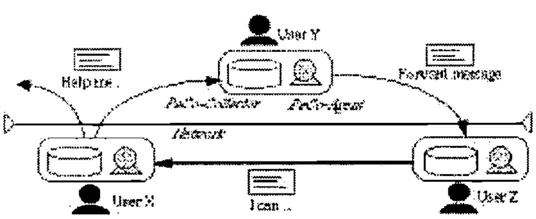

Figure 1. Overview of PeCo-Mediator-II.

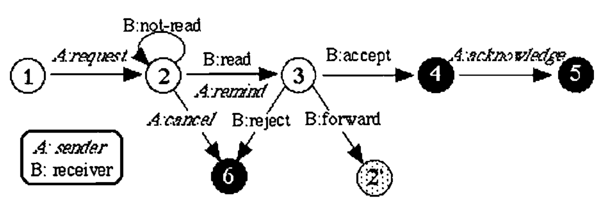

Figure 2. Data diagram of exploring social networks.

Exploration Model of Social Networks

PeCo Exploration Diagram

Figure 2 shows the data diagram of exploring social networks. User A is a sender of e-mail and user B is its receiver. Each node denotes the state during the exploration, and it moves to the next state if the user acts on the activity of the arc. The starting point is the state one and the ending point is the state four, five and six. The state 2' shows the exploration is continued from the state 2 after changing the receiver. The sender has three options: request, cancel and remind. The receiver has five options: read, not-read, accept, forward, and reject. For example, if user A sends a request to user B, the receiver either reads it or does not read it. If user B does not read it, user A may remind user B to read it. If user B reads it, s/he either accepts the request, rejects it, or forwards it to his/her friends. Until someone accepts the request or user A cancels it, the exploration of social networks is continued. Finally, user A acknowledges to user B.

Table 1. Taxonomy of users with the exploration history.

User type	Condition
Collaborator	*accept* > α and *accept* > *reject* and *accept* > *forward* and *accept* > *request*
Mediator	*forward* > α and *forward* > *reject* and *forward* > *accept*
Requestor	*reqeust* > α and *request* > *accept* and *request* > *forward*
Non-collaborator	*reject* > α and *reject* > *accept* and *reject* > *forward*
Semi-collaborator	*receive_accept* > α and *receive_accept* > *accept*

(Italic word shows the number of the action. α is a constant given by the user.)

Taxonomy of Users

Based on the above history, we divide users into the five types (see table 1):

1) Collaborator: The collaborator is a user who usually accepts the request during this system use. The collaborator is often an expert about the request.
2) Semi-collaborator: The semi-collaborator is a user who potentially has the capability for cooperation about the request. We assume that a semi-collaborator receives the answer from others rather than accepting requests.
3) Mediator: The Mediator is the user who usually forwards the request to his/her friends.
4) Requestor: The requestor is a user who asks a question and s/he becomes a stating point of exploration of social networks.
5) Non-collaborator: The non-collaborator is a user who almost rejects the request.
6) Unknown user: If a user has never received or sent a request, the user is unknown for the system.

PeCo-Agent understands the users' capability through watching the exchanges of questions and answers. We represent the capability of the user and his/her acquaintances with the keywords in the e-mail. For example, a friend is a collaborator about C programming language although the friend is a non-collaborator about Tcl/Tk.

Supporting PeCo Exploration with History

PeCo-Agent helps a user in the following situation:

1) Request support: When the user decides a receiver of the request, this system shows the user the following information about the receiver:
   a) User's type (a collaborator, semi-collaborator, mediator, requestor, non-collaborator, or unknown user): If the receiver is a collaborator, the user may find the answer easily.
   b) Strength of relationship: If the connection between the user and the receiver is strong, it is easy to ask for cooperation.
   c) The number of requests left unattended: If the receiver has many requests, his/her answer may be late.
   d) System usage: If the receiver uses this system at that time, the user can obtain the response as soon as possible.
2) Acceptance support: If the user accepts a request, the system provides the reply of the request to the user. The user edits the past results to answer it.
3) Forward support: PeCo-Agent shows the user the possible acquaintances that can help the user with the results of the past exploration. If the user has a friend who is a collaborator, semi-collaborator or mediator, PeCo-Agent recommends them as the receiver.
4) Reject support: PeCo-Agent automatically rejects the request, if the relationship strength between the user and the request sender is lower than the given value by the user.

Reducing the overload of collaborators

Collaborators are often burdened with the requests from others. To mitigate that, we propose educating semi-collaborators in this system. If semi-collaborators are educated and reach a level of collaborators, the number of collaborators increases. Therefore, PeCo-Agent recommends a collaborator to send the request to semi-collaborators and reduces the overload of collaborators. The collaborator sends the answer to the requester after checking and correcting the answer from the semi-collaborators. Next time, PeCo-Agent recommends that the requester sends the request directly to the semi-collaborator. After that, the semi-collaborator becomes a new collaborator and the requester becomes a new semi-collaborator. Moreover, the free rider issue (Salomon, 1992), which is a user who obtains information without giving any, might be settled also.

Implementation

System Configuration

We developed a prototype system on a workstation with Tcl/Tk (Ousterhoult, 1994).

(1) PeCo-Collector: This system has two components: data management and E-mail handler. All the data is managed by TRIAS (Triple Associative System) and the e-mail tool is TkMH based on MH (Peek, 1994).

(2) PeCo-Agent: The characteristics of PeCo-Agent are:

1) To represent capability of users with keywords about e-mails;
2) To obtain the capability of users from the user and other agent;
3) To move around the Internet and communicate with other users and agents;
4) To find the candidates of partners concurrently.

In PeCo-Mediator-II, a user communicates and negotiates with others through e-mail. In the same way, PeCo-Agent communicates with other agents with structured e-mail (Malone, 1986). Keywords are extracted with Chasen (Matsumoto, 1997) that is a Japanese morphological analysis tool. PeCo-Agent calculates the similarity between the given question and the stored questions by matching nouns elicited from Chasen filter.

Interface

Figure 3 shows the interaction after "aiso" asks a question to his PeCo-Agent. In the window (A) "aiso" writes the request message. In the window (B), the user sets time out for seeking social networks, the minimum strength of PeCo and the maximum steps between "aiso" and the receiver. PeCo-Agent finishes the exploration according to this setting. In the window (C), PeCo-Agent assists "aiso" to decide who is the better receiver of his acquaintances and the user agent provides information about the candidates of the receivers. The window (D) displays the list of the requests that the user has sent. The window (E) shows the flow of the exploration from he user graphically. This tree is the result of traveling with the connections of "aiso". The icons except "aiso" denote the candidates of partners. The shorter the distance between two icons, the stronger the relationship they have. While the dotted line denotes the receiver has not read the message yet, the solid line shows the receiver has already read it. The black icon means the user has rejected the request. The node icon shows the user has forwarded the message to his/her friends. The leaf and white icon means the user has accepted the cooperation. In this figure, "mendori" refused aiso's request, and "ogata", "abe", and "kawasaki" agreed to his request. "akagi" has not read the message yet. If the user reminds the reply to the request from this window, PeCo-Agent of "akagi" tells him to read the message. From this result, "aiso" is the most familiar to "goji" and can easily access the collaborator "ogata" through the mediation of "goji".

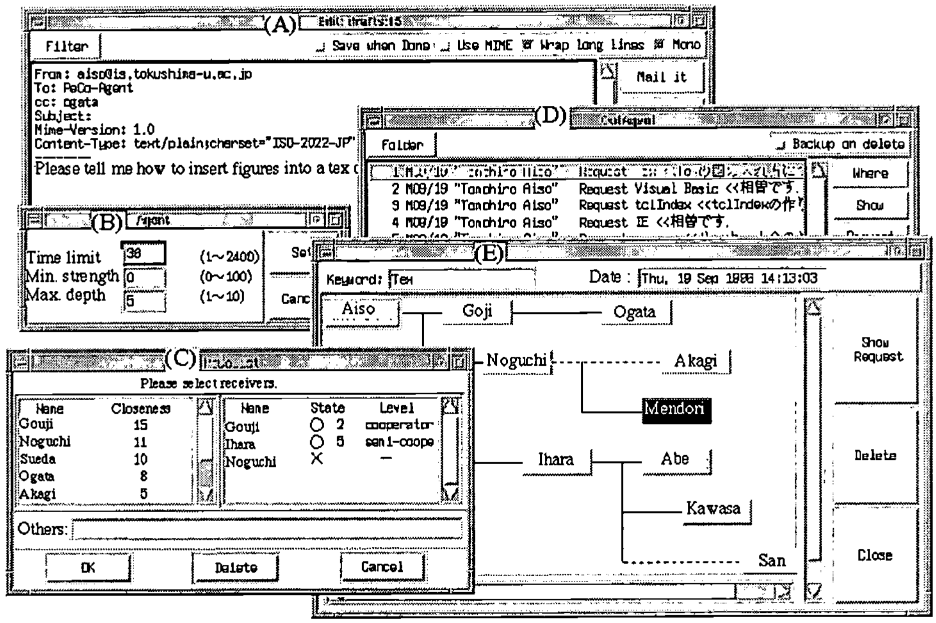

Figure 3: Screen shot of PeCo exploration with PeCo-Mediator-II.

Experimental Use

Users and Tasks

In this experiment, we arranged 13 master course students (group A) and 94 undergraduate students (group B) who had no relationship with the members of group A at the first stage of the experiment. Only one person, teacher VI, knows all the members of group A and B. They used the prototype system during nine weeks in a class of programming language C. We divided nine weeks into three terms. Teacher VI gave group B some homework every week, for example, making a program of data sorting.

Term 1: In the first three weeks, the system gathered their usual ties. Each group member communicated among the internal group members without the contact of the other group.

Term 2: We allowed group A and B to communicate and collaborate with each other to solve problems. The users solved the given problems through this system without supporting PeCo exploration with history.

Term 3: In this period, we evaluated the function for supporting PeCo exploration with the history that was stored in the term 2.

Experimental Results

Figure 4 shows the social networks between the users after six weeks from the beginning of this experiment. While the user of group A is indicated by a circle, the user of group B is shown by a square. The thick arrows denote the requested messages from the sender to the receiver. The thin arrows represent the forwarded messages over one time. The weight of the arrow shows how many times e-mail was exchanged from the sender to the receiver. The user VI was a central person and acted as a liaison between group A and B. As shown in this figure, group A and B learned to communicate with each other through the introduction of user VI, although they did not have connections beyond the group. Moreover, most of the requests from group B concentrated on user VI and III, and the collaborators were almost fixed at six persons of group A. In this case, there was no collaborator in group B.

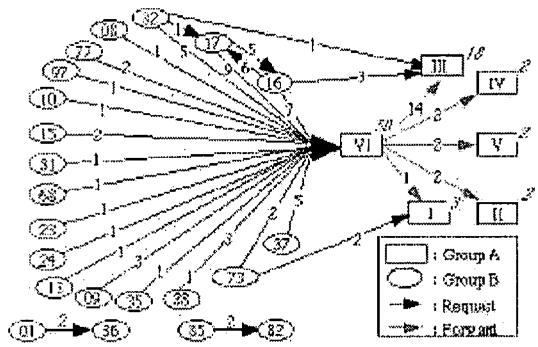

Figure 4. Network forming in the term 2.

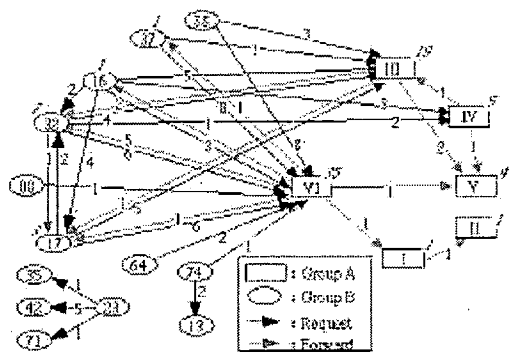

Figure 5. Network forming in the term 3.

In the previous experiment (Ogata et al., 1998), we compared this system with e-mail, mailing list and NetNews during four weeks. This experiment was executed in the same class. Both mailing list and NetNews were not often used for getting answer, because the student hesitated to ask a question. On the other hand, both this system and e-mail were frequently used. In this case, social networks were stable because direct and explicit relationships were used to get collaborative help. Likewise, (Yamakami, 1995) describes the interaction patterns of e-mail and bulletin board are stable from the long-term usage observation.

Figure 5 depicts the message flow in the term 3. Some of group B became collaborators because our system lead the users to reduce the incipient collaborators' load. For example, the system recommended user VI to forward the request from user 32 to user 17 who was a semi-collaborator. After that, user 32 directly requested user 17 to cooperate with problem solving.

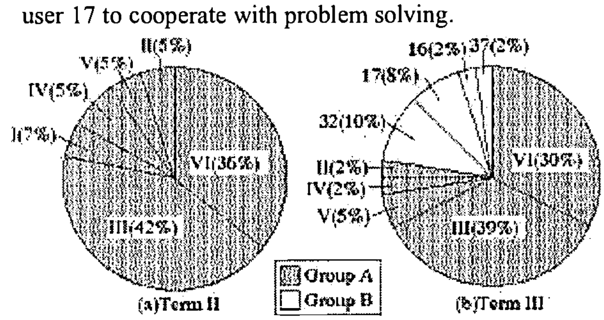

Figure 6. Rate of collaborators in the term 3.

Figure 6 shows the comparison of the collaborators in the term 2 and 3. In term 2, the user VI and II accounted for 78% of all collaborators, and there was no collaborator in group B. In term 3, the cooperation rate of the user VI and III decreased 69% and some of group B became collaborators. This experimental result seems to show that the facility of this system is available to prevent the collaborators from being fixed and to facilitate mutual cooperation. In the term 3, the users provide their knowledge into the shared repository.

Conclusion

This paper proposed PeCo-Mediator-II as a support to find capable collaborators with the chain of personal connections in a collaborative learning environment. This system helps gathering, seeking, and visualizing social networks of organizational members. PeCo-Mediator-II is an agent-based system to deal with e-mail. This system consists of PeCo-Collector as a personal database and PeCo-Agent as a user's assistant. PeCo-Mediator-II was experimentally tested and evaluated in a C programming language course. The results showed the system could help the user to encounter a collaborator and developed the new relationship with the collaborator.

Acknowledgment

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A Meta-analysis of Learning Evaluation Online: LEO's Useability, Adoption, and Patterns of Use

Albert Ip
The University of Melbourne, Multimedia Education Unit, Melbourne, Australia 3052
Email: a.ip@meu.unimelb.edu.au

David M. Kennedy
Monash University, Centre for Learning and Teaching Support, Australia
Email: david.kennedy@CeLTS.monash.edu.au

Abstract: The design, development, implementation, and evaluation of Web-based courseware for teaching and learning are important issues in higher education. However, available evidence suggests evaluation of much courseware is minimal.

This paper reports a meta-analysis of the adoption, usage, and implementation of a generic, customisable, online survey / evaluation software tool—Learning Evaluation Online (LEO). A customisable evaluation tool derived from the need to:

- customise each survey to suit each particular project,
- collect data from widely geographically separated evaluators, and
- decrease the time and expense of data collection and evaluation.

LEO was also designed to be customisable by individuals with minimal computing experience. Templates for basic evaluation question types are provided. The use of LEO was logged by the LEO software engine and our LEO-on-LEO survey. An analysis of the quantitative and qualitative data generated is presented together with recommendations for improving implementation of similar tools.

Introduction

In the recent past, the evaluation of courseware has often occurred when the project is nearing the end of the software development. However, this is changing as the perception of the value of formative evaluation has improved (Barker, 1995; Beattie, 1994). Laurillard (1994, p. 287) suggested that "formative evaluation has a vital role to play in the progress of multimedia because it is the means by which we build up our knowledge of what the medium can do".

Learning Evaluation Online (LEO) was originally developed as a survey / evaluation tool in response to a need for an asynchronous Web-based evaluation mechanism, that could be easily modified to suit a variety of potential respondents (e.g., peers, students, multimedia developers, interface designers, etc.), and courseware from various content domains. We also wanted to decrease the time and expense of data collection and evaluation. Other systems have been reported (Recker & Greenwood, 1997). However these systems lacked the ability to be used easily by non-programmers. A system such as LEO had the potential to make evaluation of courseware less problematic—in terms of programming, deployment, and adaptation for a range of evaluation or survey needs.

The LEO software environment is a template using the first author's OXYGEN (Object eXtensible analYsis and Generation of Education coNtent) software engine. The authoring capability of the OXYGEN software engine is extremely flexible, making it very adaptable for a wide variety of potential for uses, and users. Initially, LEO was developed to meet the needs of evaluating interactive Web-based learning tools then under development at

Multimedia Education Unit, at the University of Melbourne (Kennedy & Fritze, 1998; Kennedy, Ip, Eizenberg, & Adams, 1998). LEO has a number of purpose built features that support:

- the creation of the survey objectives as a hyperlink,
- the entry of the purpose of the survey,
- the generation of common demographic details, and
- seven different pre-defined question styles, including Likert scales, true/false items, free text responses and a custom style.

A more complete description of the basic functionality of LEO may be found in (Kennedy & Ip, 1998).

A Generic Survey Tool versus a Specific Measuring Instrument

LEO was designed to meet a specific need—evaluation of Web-based courseware. However, it is a tool, not an instrument. Most published survey or evaluation instruments are in paper form (e.g., the Course Experience Questionnaire (Ramsden, 1991)). An instrument is designed to measure specific parameters and therefore requires validity and reliability studies. Any survey developed with LEO would have to be rigorously analysed and validated to ensure reliability and validity.

However, LEO has been implemented as a generic tool, making little (if any) assumptions about the objective of any particular survey or the information the survey author may be seeking. No specific items have been defined except a limited number relating to the demographic details of the respondents—those too have been customised in response to requests from survey authors. In summary, LEO is a tool that provides:

- ease of question authoring (we believed),
- a simple method of deployment to potential respondents, and
- a mechanism for the survey author to retrieve the data and export it to a statistical package for further analysis.

In this paper, we shall use the term "lecturer" to refer to the survey author. The authors of this paper have used LEO to formatively evaluate two Web-based interactive learning tools (Kennedy & Fritze, 1998; Kennedy *et al.*, 1998). However, the wider use of LEO by academics may also provide insights into the uptake of generic software tools of this type in higher education.

We hypothesised that the value of LEO to the wider academic community would be:

- its ease of authoring,
- customisability by the lecturer,
- short developmental time between authoring and actual delivery of the survey, and
- the return of any data generated in electronic form.

We shall report on these factors in later sections of this paper, Both qualitative and quantitative data was generated by a LEO survey (using LEO, of course) and further quantitative data captured by the usage log of LEO (the actual content of each survey is confidential).

Using LEO

LEO is entirely web-based. The LEO web site (http://www2.meu.unimelb.edu.au/OXYGEN/LEO/), asks potential users to fill in a simple web-based form with the user's name and email address, and proceed to the authoring environment . An email is returned to the lecturer to her or his email address with:

- the assigned survey ID;
- a password, and the name of survey author—required to author the survey and later to collect survey data;
- the uniform resource locator (URL) to which the respondents may be directed;
- a URL for collecting survey data in table form, and
- a URL for collecting survey data in comma delimited form.

In addition to the password generated (provided automatically by the LEO system), one more level of security can be obtained by using a random letter user name.

Authoring a LEO survey or questionnaire

Once the survey author has entered the LEO authoring environment with their password the lecturer may choose to enter the following information:

- a title for the survey,
- a brief introduction to describe the purpose of the survey for potential respondents,
- the objectives of the survey, which will be available to the respondents as a hypertext link,
- the demographic details the lecturer wishes to collect, and
- the first survey item.

After clicking on the *Submit* button, the lecturer will be prompted to provide subsequent items. The question style of each item is chosen from a list. The process continues until the *Finish* button is clicked. In order to facilitate more complex formatting (for authors who require it), all data entry fields are html (hypertext markup language) active. Text with html tags may be entered directly into the data entry fields (e.g., <B>My survey</B> would result in **My survey** in bold). In Figure 1 (Fig. 1) the basic question entry template is shown with a bipolar Likert style question as the selection in the popup menu used to decide the question type.

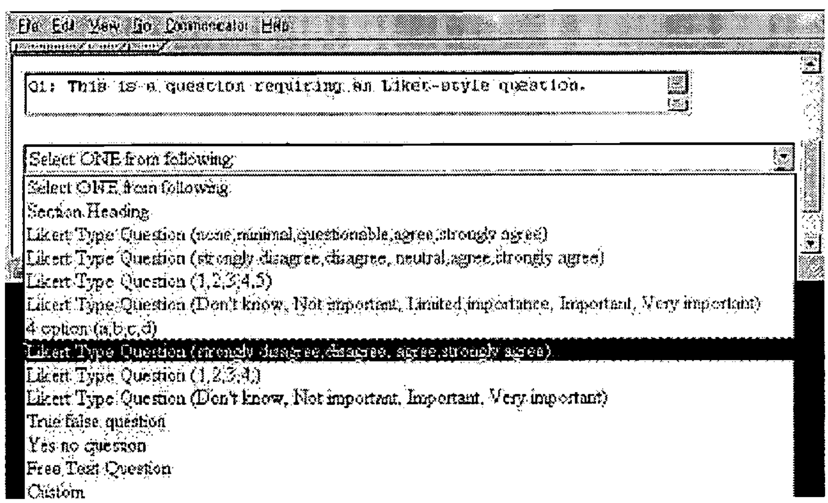

Figure 1: Choosing a question template with LEO

Survey delivery

The LEO system incorporates a database to store the data generated by the survey. Respondents access a LEO survey by clicking on a hypertext link in a web-page. The LEO server creates the survey in a window in the html browser of the respondent. This process enables lecturers to create an online survey without the need for programming skills, knowledge of html, or server management experience. The LEO project web site is currently hosted by the experimental web server at MEU, the University of Melbourne and is available 24 hours 7 days a week, the database being backed up daily at about midnight, Melbourne time.

Results retrieval

The lecturer accesses the results of a survey in the form of a html table or comma delimited text file. The comma delimited text files can be imported to most statistic packages and/or a spreadsheet with minimal difficulty.

LEO on LEO

We have created a LEO survey on our project web site to evaluate the authoring process and the use of the tool. The stated purpose of LEO-on-LEO survey is to, improve the functionality of LEO, determine the uses to which LEO is being put, determine the potential requirements for more pre-defined question styles for survey authors, and improve the performance aspects of LEO (e.g., time for the survey to load to the respondent's browser, or response to a survey submission).

Evaluation of LEO

The data we are able to generate from LEO users are:

- who and how many surveys have been constructed by individual users (from name and email address);
- the number of respondents who complete each survey;
- the time period over which the survey operates;
- the number of surveys that are constructed as part of the learning process of generating a LEO survey;
- the lead time between survey creation and data collection; and
- feedback from the LEO-on-LEO survey.

From the usage log, we found that between March, 1998 and October, 1998, LEO has collected 20780 data points from 599 respondents with the 235 potential surveys created. However this data includes the demonstration surveys we did for academics, and some test surveys generated during minor modifications of the functionality of LEO. In fact, the first author has created 56 surveys and only two are in real use. The second author has created 43 surveys with 4 in actual use. One of the 235 surveys is the LEO on LEO survey mentioned above.

The log shows that there were 75 users other than the authors. From the email addresses supplied, there are 3 users from outside Australia. Demonstrations of LEO in the United Kingdom, Sweden and Germany during 1998 on computers with Macintosh and PC operating systems did not result in any significant time delays in comparison to surveys developed and deployed locally. Of the 75 individuals who investigated LEO, 26 individuals created two or more surveys (excluding the authors of this paper). In our experience most people accessing the LEO site did so to have a brief look at the tool. At the time of writing, only one lecturer (beside the authors) has produced more than one survey for active use.

The time between the creation of the survey and the first use of the survey varied from 2 minutes to 63 days. Generally, the longer the time delay, the more likely the survey was intended to be used for genuine data collection.

Out of the 235 potential surveys, only 30 surveys have more than 2 respondents. Table 1 shows the distribution of respondents to the number of surveys that have that number of respondents. This data suggests that academics are interested in a LEO-like tool. However, in many cases they were not yet in the position to use LEO. Typically, developing online courseware requires a significant lead time and many academics indicated they would be using LEO in the future, once the courseware had been developed. Indicative of the process of creating an active survey are the surveys with the larger response rates (58, 63, and 112 respondents). These surveys required 2, 7, and 3 attempts respectively. Some of the surveys are still generating data (Feb. 1999). The lecturer who required 7 attempts customised the survey substantially using the html facility of the LEO template.

This data confirms that LEO is easy to learn using the templates provided, but customising any particular survey (using html) will require a greater investment in time. From initial data we estimate the learning curve to be about 3 to 5 attempts in order to get a survey into a format satisfactory to the lecturer. We have no evidence to indicate which is the limiting factor—authoring using the LEO templates, or constructing the survey.

Respondents	Surveys	Remarks
2	5	Most likely, these are test surveys.
3	2	
4	4	
6	2	
7	4	One of the survey here is our "LEO on LEO" survey
11	1	For surveys with respondents number in this range, we suspect that they may be course evaluation surveys representing about 30% to 40% response rate
15	1	
17	1	
26	1	
42	1	
44	1	
52	2	
58	1	
63	1	
112	1	An survey in the medical faculty (by the second author)

Table 1: Number of respondents and survey numbers

Informal discussions and feedback from the LEO on LEO survey have indicated that few survey authors access the FAQs in order to find out the best way to approach the task. Most seem to prefer to try it and see. From our LEO on LEO survey, one lecturer commented that she was:

> Rather fussy about layout and (the lecturer) wanted the survey to look as good as a paper one would be.

The lead time (the time of first registering for a survey and the time the first response was collected) ranges from 8 minutes to 147 days. Generally, surveys with a short lead time (in the order of minutes) are test surveys. The 147-day lead time survey was later identified (by the course advisor) to be a well planned formative evaluation for a new web-based course at The University of Melbourne.

The LEO on LEO survey only generated 7 respondents (a disappointing result—not unlike the problems with paper-based evaluations, not all potential respondents complete the survey). Two respondents used LEO for formative evaluation, one for a questionnaire to obtain contributions from students and teachers to facilitate the construction of a resource database, two for formative and summative evaluation, one for evaluation of student use of a new anatomy CD-ROM and one as end-of-course evaluation. Comments supporting LEO and the LEO authoring interface included the simplicity of the authoring interface, ease and speed of deployment of the survey, and ease with which surveys for a range of potential respondents may be constructed. Actual comments from the LEO on LEO survey include:

> That it is Web deliverable, relatively easy to use once you've got the hang of it and quick. I could never have got a paper survey out in such a short time.
>
> Once you know how to use it, putting a survey online is so quick.
>
> It's easy for a non-computer person to handle.

The lecturers identified the following weaknesses of the current implementation, including:

- a need of more Likert tags (the descriptors used to discriminate the level of response);
- limited editing capability of items of the survey once submitted
- no choice of background graphics at present; and
- the need to manually modify the data collected before exporting to a spreadsheet.

Future Directions

In seven months of operation, LEO collected over 20,000 pieces of data for 75 users from a range of different surveys. It has been extremely reliable. We estimate that LEO has saved over 100 hours of transcription time, postage, and maybe a tree. Lecturers recognise the value of access to a tool such as LEO and we expect many more users next semester, once the online courseware currently under development are in use. There are a number of areas in which the current iteration will be improved. We are working in the following areas:

- more templates variations to cater to broader needs,
- more secure means of delivering the survey,
- faster response from the underlying OXYGEN engine,
- exporting the survey data into Excel spreadsheet with built-in frequency counts, barchart generation and cross-tabulation for preliminary data analysis (almost complete at the time of writing).

The experience with LEO provides evidence that designing online tools that are generic rather than prescribed, customisable rather than fixed, and easily adapted by non-programmers, overcomes some of the issues of the 'not invented here syndrome' prevalent in much software use (Australian Vice Chancellors' Committee, 1996). One of the most satisfying outcomes our evaluation of LEO has been the discovery that lecturers are using the tool in ways we didn't imagine.

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Moving from an Instructivist to a Constructivist Multimedia Learning Environment

Jan Herrington
University Learning Systems
Edith Cowan University
Perth, Western Australia
j.herrington@cowan.edu.au

Peter Standen
School of Management
Edith Cowan University
Perth, Western Australia
p.standen@cowan.edu.au

Abstract: This paper describes the transformation of a multimedia program, designed to teach research skills to business students, from one based on an 'instructivist' model to one underpinned with a constructivist philosophy. The revised program uses the theory of situated learning as a framework for the instructional design, and introduces elements such as authentic context, an authentic activity, collaboration, and opportunities for articulation and reflection, into the learning environment.

Introduction

Over the past decade or more, there has been a substantial theoretical shift from a 'behavioral to cognitive to constructivist' learning perspectives amongst educators (Ertmer & Newby, 1993, p. 50; Jonassen, 1991; von Glasersfeld, 1995). Little credence is now given to learning theories that propose that learning is no more than the transmission of a body of knowledge from teacher to student. No matter how much teaching methods in the classroom have changed, the theoretical foundations of interactive multimedia programs are frequently found to be based on behavioral traditions inherited from educational technology. As Jonassen puts it: 'The roots of behaviorism extend deeply into IST [instructional systems technology] practice' (Jonassen, 1991, p. 6). It is possible, even today, to find many examples of multimedia learning environments which use the same instructional design as the early programmed instruction texts of the 50s.

It is one such multimedia program which we describe in this paper—a program firmly in the behaviourist mould, which attempted to take the subject of research methodology and transmit that knowledge in a linear fashion through eight modules and 26 lessons. The program was based on a pedagogical philosophy described by Reeves and others (Reeves, 1993; Duffy and Jonassen, 1991) as 'instructivist' where little emphasis is placed on the learner 'who is the passive recipient of instruction' (Reeves, 1993, p. 4). The program had been under construction for about two years, and had already swallowed up a substantial amount of funding. The Faculty was committed to the program's completion. But we both envisaged a far better way to create a learning environment to teach research methodology. We planned to design a constructivist shell to provide a meaning to the lessons that comprised the original program.

Some educators, such as Squires (1996) have spoken of programs designed from a constructivist philosophy being used in very non-constructivist settings. Young, Nastasi and Braunhardt (1996) relate their experience of implementing 'a constructivist design in a constructivist manner' (p. 121). Clearly, the software itself is but one aspect of an interrelating group of influences which may determine whether learning is successful. Our plan was to incorporate a 'non-constructivist design' into a learning environment based upon a constructivist philosophy.

An Instructivist Learning Tool

The original program comprised a multimedia package for teaching statistics and research methods in a business degree, traditionally taught by lectures and tutorials. As in many similar courses, mastering the theory took most of the time, leaving little room to explain its application and the practicalities of using it in business. A first attempt to improve the course recognized the power of multimedia to present technical material in a self-paced format (Figure 1), using multiple choice or other closed format exercises to help students test their understanding at each stage. This approach was based on the typical transmission model of learning, made interesting with multimedia features like graphics, animations, and interactive exercises. However, unlike a lecture, students could also repeat sections of the course until the concepts were mastered.

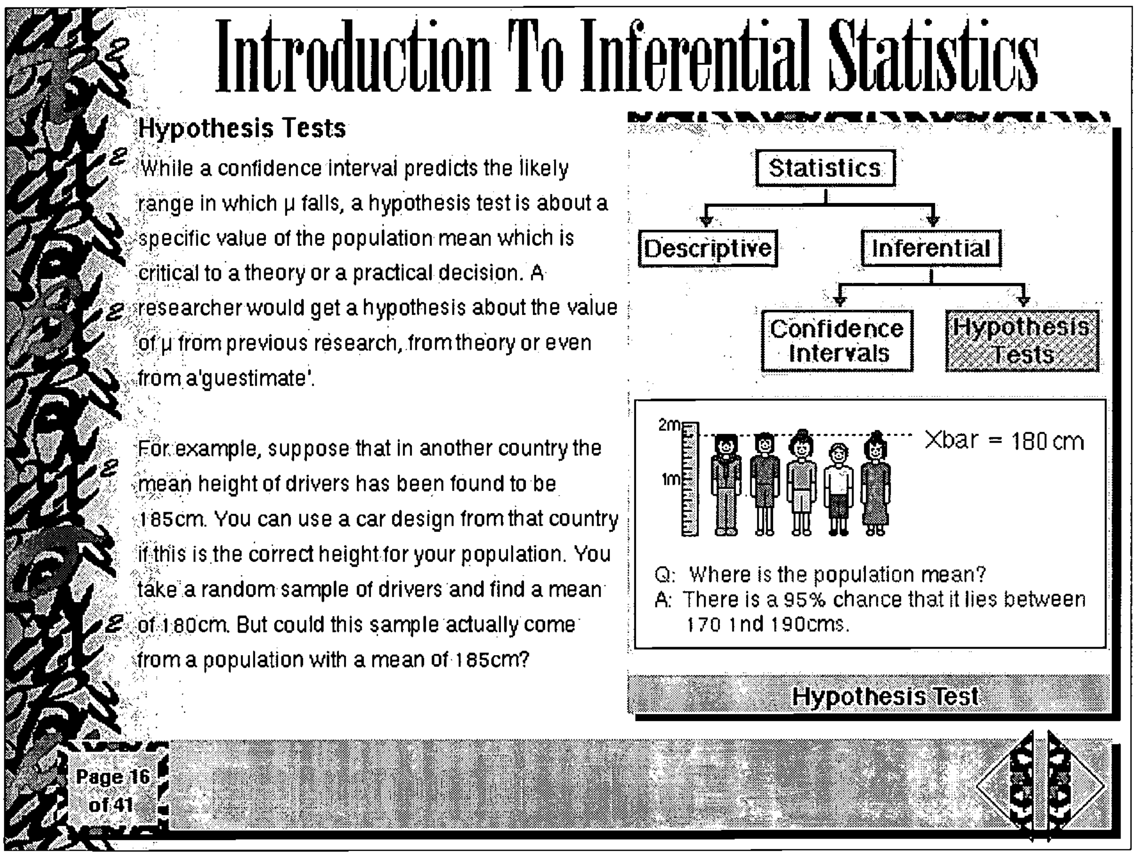

Figure 1: Instruction screen

The resulting 'electronic textbook' had some advantages over traditional lectures and tutorials, but pilot testing showed it did not really solve a major problem of the course: that the technical material was boring when studied in isolation from its application. Students lacking work experience could not make the connection, and business students are renown for their resistance to teaching that is not apparently relevant. The attractions of self-pacing, constant feedback and animations were acknowledged, but the trial revealed no improvement in students' motivation to work through the many steps needed to understand the material. In hindsight, self-pacing and constant feedback can be seen as *reducing* the quality of teaching: students could not turn off when the material was difficult, nor use their considerable skills at answering tutorial questions with very partial knowledge. A solution designed to increase learner control worked on one level, but had the reverse effect on another and was actually judged worse or no better than traditional methods. The following sections describe the philosophy we adopted and how we designed a more constructivist learning environment to incorporate this original program.

Situated Learning

In designing our 'constructivist shell', we wanted to provide a real-life context and meaning to the learning that the students were required to do as they worked with the program. In so doing, we drew heavily on situated learning theory (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991; McLellan, 1996) which emphasises the notion that the learning process cannot be divorced from the context of the problem, and that the learner will use information and clues from the situation rather than apply formally taught problem-solving techniques. Resnick (1987) contends that school and university learning is fundamentally different to everyday, practical learning in that it provides too little engagement with genuine situations, and too much emphasis on theoretical perspectives. Above all, we wanted the learning environment to more closely resemble the way learning occurs in real life than it does in formal school and university settings.

From the literature on situated learning, it was possible to produce a list of nine critical criteria (Herrington & Oliver, 1995) that could be used to guide the design and development of the interactive multimedia which was to comprise the constructivist shell. The program needed to provide:

1. *Authentic context that reflects the way the knowledge will be used in real life*

The program needed to be able to encompass a physical environment which reflected the way the knowledge would ultimately be used, and a large number of resources to enable sustained examination from a number of different perspectives (Brown et al., 1989; Honebein, Duffy, & Fishman, 1993). The context chosen was a large research company, with all its resources and infrastructure, where the students gain temporary employment.

2. *Authentic activities*

The learning environment needed to provide ill-defined activities that have real-world relevance, and which present a single complex task to be completed over a sustained period of time (Bransford, Vye, Kinzer, & Risko, 1990; Brown et al., 1989). The authentic activities in the program include three research 'jobs' on the students' desk when they start work, each of which require 2-4 weeks of a semester to complete.

3. *Access to expert performances and the modelling of processes*

In order for the learning environment to provide expert performances, the program needed to provide access to expert thinking and the modelling of processes (Brown et al., 1989; Collins, Brown, & Newman, 1989; Lave & Wenger, 1991). The program provides examples of completed research projects to enable students to examine professional research reports.

4. *Multiple roles and perspectives*

In order for students to be able to investigate the learning environment from more than a single perspective, the program needed to provide different perspectives on the topics from various points of view (Collins et al., 1989; Honebein et al., 1993; Spiro, Feltovich, Jacobson, & Coulson, 1991). In each of the research scenarios, the students need to interview a number of different employees within organisations to obtain information, and to consult a variety of other resources.

5. *Reflection*

In order to provide opportunities for students to reflect on their learning, the program needed to provide both an authentic context and non-linear navigation to enable them to return to any element of the program (Boud, Keogh, & Walker, 1985; Collins & Brown, 1988; Kemmis, 1985). Unlike the original research methodology program, which followed a linear form, the new shell enabled students to navigate at will within the resource.

6. *Collaborative construction of knowledge*

The learning environment needed to provide the opportunity for students to collaborate, and while this could not be incorporated within the software itself, it is recommended that students work on the program in small groups to enable them to problem-solve together (Brown et al., 1989; Collins et al., 1989; Hooper, 1992).

7. *Articulation*

The learning environment needed to ensure that students were free to discuss the task as they use the program to enable them to learn to speak the language of the discipline and community of practice (Collins et al., 1989;

Lave & Wenger, 1991). Unlike the original program which was designed for individual students working silently on their own, the new learning environment encouraged the students to articulate their growing understanding of the research methodology with their partners.

8. *Coaching and scaffolding*

The learning environment needed to ensure that the teacher was available to provide required coaching and scaffolding for students as they used the program (Collins et al., 1989; Greenfield, 1984).

9. *Authentic assessment*

In order to provide assessment of student learning compatible with the situated learning model, the program needed to provide assessment that was seamlessly integrated with the activity (Linn, Baker, & Dunbar, 1991; Reeves & Okey, 1996; Wiggins, 1993). Students are assessed on the research report that is the purpose of their work at the research agency, rather than on the separate quizzes and tests of the original program.

A Functional Learning Tool

While this constructivist style of multimedia is not as simple to create as the instructivist electronic textbook, it has many advantages: it shows the relevance of theory to application; learning of theory is driven by the need to use it, rather than an artificially imposed pedagogical framework; and field experiences closer to professional realities than simplified student projects can be simulated. The context is modeled on the experience of a student employed as an apprentice in a summer job with *Acumen Research* to undertake research for a client, a large bank. In their office at *Acumen* (Figure 2) are various resources, including information on office procedures (principally on navigating in the simulation) and a folder containing information on the project.

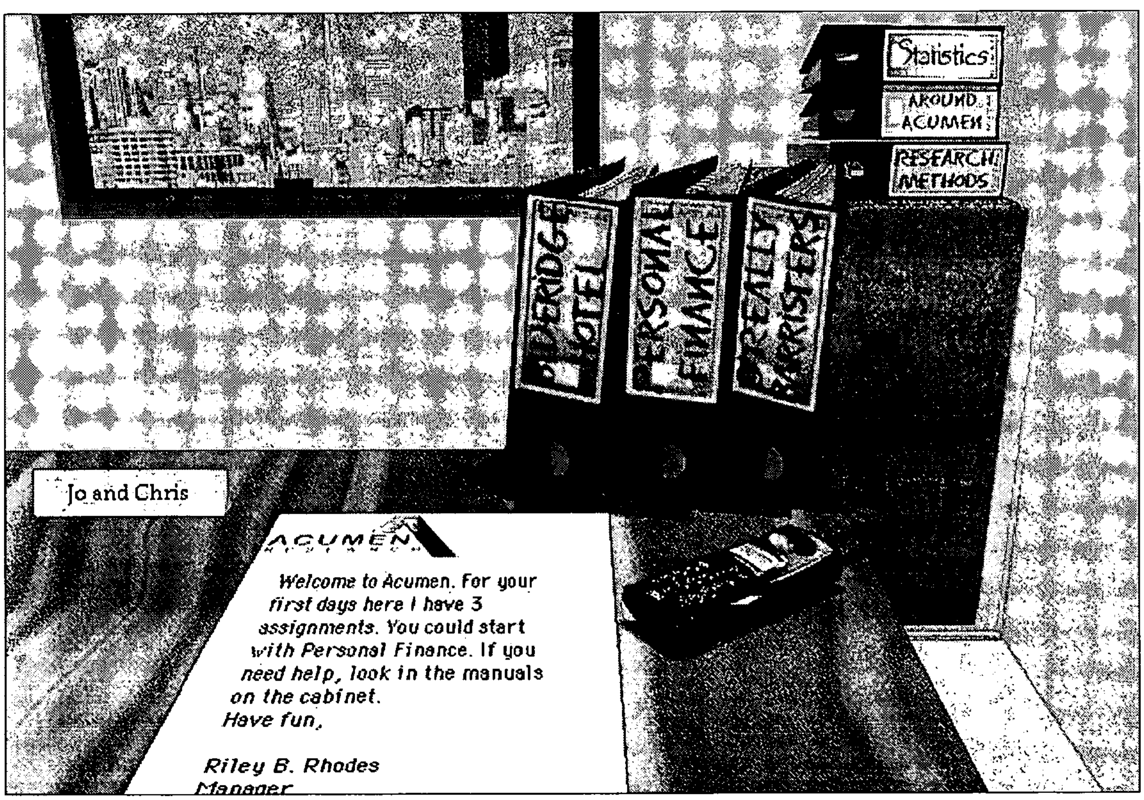

Figure 2: The office at Acumen

The books on research and statistics are the electronic texts described earlier: students do not now have to use them except as they need to supplement learning from other sources to complete the project. Two general resources available throughout the simulation are a phone that provides context sensitive help (e.g., hints on what to do next), and a notepad primarily for taking notes or storing information. No instructions on using the program are needed as navigation involves only clicking on objects or people to perform activities as they would be done in the real situation. After familiarizing themselves with the resources, students are directed to the client's office. There they meet the manager commissioning the research and have a preliminary 'discussion' on the nature of the problem as he sees it. This involves a statement by the manager, followed by the opportunity to choose questions from a list in the notebook (the manager's statement and responses are video clips). Students are expected to choose questions with some thought to the situation: there is not time to answer all questions, and some are largely irrelevant to the problem. Students work in pairs, and are encouraged to discuss their choices.

The manager subsequently invites the student to discuss the project with a senior staff. They learn in these discussions that the problem has other angles and must be reframed to meet the needs of the various organizational members. Apprentices are told beforehand that, as in the real world, there may be no one right way of construing the problem, but that some views may be more politically important than others. These are often unexpected and interesting issues to students, and not readily available in the traditional teaching approach. After constructing their version of the problem, students design a questionnaire by selecting questions from a large bank of items used in previous surveys. Next, they choose the sampling design from a set of alternatives; tradeoffs between scientific accuracy and costs invite students to see theoretical principles in the context of real world constraints. On finishing the research design tasks, students receive their data, which has been 'collected' by a group of telephone surveyors employed by the research agency. Finally, the data are downloaded, analyzed in a standard statistics package, and written up. The report can be evaluated by the lecturer, authentically, in the same way its real-world counterpart would be.

Behavioral to Constructivist

In designing a constructivist shell for a behavioral interactive multimedia program, we deliberately sought to adopt an approach which saw learning as an active process rather than the result of a transmission of knowledge from program to student. The tasks that were designed for the program were global, complex and sustained, rather than clearly defined tasks and subtasks, neatly broken up into lessons and modules. These tasks were placed within a full and authentic context rather than fragmented tasks and pre-determined instructional sequences. The new program required and encouraged students to explore the learning environment, rather than be captive to the presentation of a number of linear lessons. It presented a complexity which required more reflective thought than the step-by step lessons of the original program. Students were required to select relevant data and material from a wealth of sources, rather than try to absorb a pre-determined and well-defined body of knowledge. In so doing, they were required to reflect about their path rather than progress automatically through it. The interface of the new program used an ecological approach (Pejtersen, 1993) which presented real world metaphors and objects rather than buttons as navigational devices. Students would need to associate the meaning of an object with its destination rather than click upon the ubiquitous forward and back arrows of the original program.

In its implementation, the learning environment moved from a purely individual and solitary pursuit to a collaborative one, supported by a teacher who could provide coaching and scaffolding at appropriate times. Assessment of learning became integrated, authentic and inseparable from the activities themselves, as opposed to the separate tests and quizzes designed to assess decontextualised packets of learning.

In the real world, unlike the classroom, practitioners actively construct their understanding of a problem, and design a sequence of problem-solving steps based on both the textbook principles *and* contextual factors. The program described here provides an understanding of how the theory behind research functions in the face of ambiguous and contradictory information, practical limits on time and budget, and social agendas. In so doing, it provides students with a learning environment no longer based on the instructivist models of the 50s, but one firmly grounded in recent theory and research.

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A Web-based Virtual Education System for Tele-training Courses

S. Sioutas, J. Tsaknakis, A. Tsakalidis, B. Vassiliadis
Computer Engineering and Informatics Department
University of Patras
and
Computer Technology Institute,
Greece

Abstract: The need for a higher integration of training and work is becoming increasingly apparent in countries such as Greece where the costs for higher education have lead to a permanent development process of the educational culture. In this paper we describe our ongoing work on an educational system which properly exploits the recent advances in information & communication technologies and addresses efficiently the above need. This effort aims to the development of the necessary infrastructure and services in order to establish a complete "Virtual Education System" offering tele-training services based on WWW technology.

Introduction

Internet has became an integrated set of inter-networking resources and services based on open, de facto standards and offered by an array of competing providers in a commercial environment now exhibiting many of the features of a commodity market. The World Wide Web (Web) and its attendant browsers, with their origins also in the research and academic communities, catapulted the Internet to its current revolutionary status as an educational phenomenon [Bertrand et al. 1995].

Today, training in Greece is characterised by classroom seminars where computer technology (multimedia systems) is used occasionally. But the latest progress in the field of computer networks has not been taken into account yet. Many educational institutions own World Wide Web servers thus providing information on their interest areas, their achievements and goals. In the Internet, a large number of digital libraries containing a wide amount of knowledge are able to provide information but they are not oriented for on-line training. Moreover, in the last few years, Greek universities offer off-line tele-training via the Web.

The Virtual Education System described in this paper is an on-line, web based educational platform which aims to enable the user to exploit the capabilities and tools offered today due to the progress of computer science, in order to:

- access multimedia information about relevant educational subjects
- communicate with other users sharing the same interests and exchange ideas end knowledge
- develop new skills
- keep in touch with the recent advances that affect working methods

The system addresses the need of restructuring traditional vocational training concepts in order to support current educational requirements such as effective integration of work & training, flexibility, in place-training needs and wide exchange of experience and problem solving methodologies.

In this work we present the overall architecture of the system which currently exists as a prototype. The paper is organised as follows: section 2 describes the main objectives of the system. Section 3 presents certain issues that are posed when developing distance education systems over the Internet. Section 4 presents the general architecture and the technological aspects of the system and finally, section 5 discusses future directions.

Main Objectives of the Proposed System

The educational concept of the system is characterised by the transformation of theory into practice. The course modules are separate entities, and play the role of plug-ins to the system. The Virtual Education System plays the role of a customised borwser and collaboration tool, which fully facilitate the Greek language providing a simple and friendly user interface [Tritsch 1995]. This feature allows even novice users to operate complex services (like video conferencing) with little effort.

Each course module deals with a specific subject (e.g. computer science or algebra) and is constructed using special WYSIWYG authoring tools. This way, the training material is system independent and every educational author can construct his own courses. The only limitation is that certain lesson architecture rules should be followed in order for the module under construction to be compatible/readble by the system. Each subject is not taught point by point but as an integral whole and through action oriented methods. This serves to promote the process of "natural learning" working in teams and projects and is oriented on future personnel development conceptions [Goldberg 1996].

The users can communicate over virtual education centres with tutors, experts as well as other users (see figure 1). The design of these virtual systems has the aim to link all functions under a uniform surface. All functions can be used single or combined which means that they can be used for:

- communication
- learning
- any combination of the above

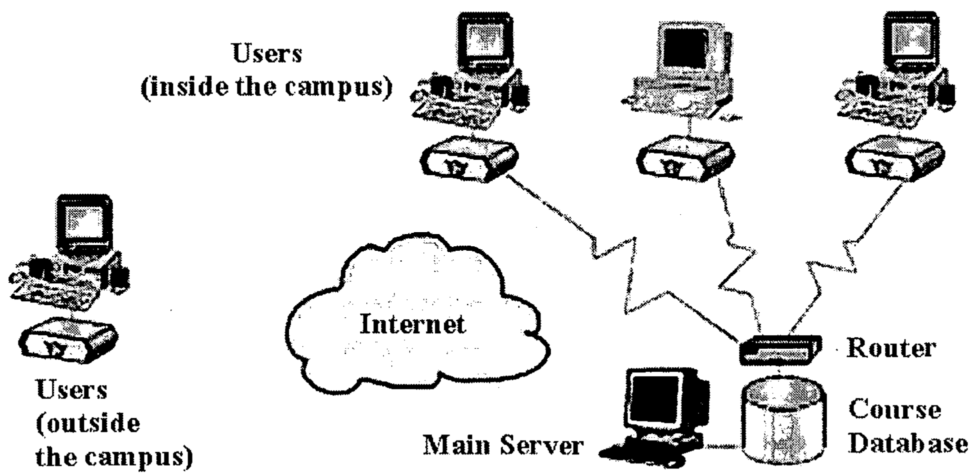

Figure 1. The topology of the system.

The Virtual Educational System will use all recent advances in the fields of information & communication technologies, in order to achieve:

- *Integration of working and training*. The process of learning will change in accordance to the developments of work processes. Working and learning will be more and more linked together so that the education and working processes of the future will show an increased degree of integration.
- *Realistic training for the users*. Being connected with modern working environments, they will have the opportunity to be trained according to the latest demands of the market.
- *Lifelong and autonomous learning*: The user has the capability to learn at home and has the opportunity to communicate with tutors, other users or experts.
- *Flexibility with regard to time, place and intensity of learning*: The user has the choice of place, intensity

and duration of study.

- *High training level* with the use of new technologies like the integration of multimedia technology systems (offering images, sound and video) and computer networks which allow the user to access information from digital libraries of other institutions (open and distance learning and computer based training).
- The exchange of experiences, knowledge and ideas between people separated by large distances.

3. Issues for Distance Education Applications that use the Internet

During the design period of the system we faced several topics that needed to be addressed before being able to offer a complete Virtual Education System over the Internet. These range from technical considerations to sociological aspects of learning without the existence of a physical classroom. Much study has already been done in distance education. While distance education can provide efficient utilisation of scarse resources, more fair distribution of knowledge, and timely dissemination of new knowledge, limitations in its effective use exist. Student motivation is critical. On-line instructors may need to take more time for the electronic courses. Limits to the number of students may be required to maintain quality interaction. While generalisations in the effectiveness of distance education are dangerous, a common set of advantages and disadvantages are emerging [Rossman 1992].

The web solves some problems of traditional distance education and brings new issues to the forefront. During our work we adressed the following issues:

- **Target Audience.** With traditional university courses, attendance is limited by the physical size of the training facility (about 50 students). Normally this means that the attendees are users and potential users of our facilities –researchers whose backgrounds, computing experiences, and expectations are somewhat similar. With a Virtual Education System, the size of each class will be limited by other non physical factors such as staffing requirements for account administration, limited consulting support and CPU resources required for the provision of on-line services. While we may now be able to directly impact a broader group of people, this group will be likely much more diverse in its background and computer experience. Having in mind the above problems the following issues are posed:
    - the policy on the individual computer accounts
    - the way that novice users will be supported by e-mail services and newsletters
    - the security policy that must be followed since the application should be protected from outside intruders.
- **Prerequisites.** The use of the system will require some basic knowledge of Windows, the main operating system used by the majority of Greek users. With traditional workshops held in training facilities the type of computer hardware, software and network connection is known. Although many of these parameters (such as network speed) are known in a University environment, the users coming from outside (e.g. logging in from their homes) have unknown properties. This situation could cause a number of problems. For example, some users may find that limited network bandwidth (a common problem in Greek public networks) does not provide a satisfactory learning environment. A simple solution would be to decrease the volume of the material (e.g. limit the use of multimedia) but this would mean reduced quality of the educational process. Since our main purpose was to have a fully interactive and media rich system, the use of multimedia objects was extensive even though some users would be eventually excluded from the learning process.
- **Learning Environment.** Extensive feedback from attendees at traditional workshops indicated that there were two benefits to learning in a classroom setting which were independent of the material covered in the course. First, students find the ability to get away form their other responsibilities and concentrate on learning the course material greatly increases the amount that they learn and retain. Second, the interaction with other students and instructors, whether this was side discussion or simply listening to questions asked by others, often resulted in rethinking of their own techniques and suggest new solutions to their problems. Our system should have the same attributes in order to ensure that students find the experience worthwhile and complete the course. This need can be satisfied only when the learning environment provides advanced interaction between instructors and students with the ability of whole classrooms to participate in questions and answers.

Technological Aspects of the System

The project aims to develop tools in order to combine the classical education methods into a complex, but efficient, system based on new technological achievements in the field of information & communication technologies. The technical basis of this educational system is formed by a virtual education centre that provides interactive educational courses over a data network. Precondition for the virtual education centre is an integrated software environment which makes possible that several users, tutors and experts use all different capabilities of the educational system at the same time [Repenning 1993].

New technologies are contributing to major transformations in the way people live, learn, work and interact around the globe. Important new technologies such as networking / internetworking, tele-communication, presentation / authoring, collaboration, visualisation/imagery analysis, conferencing and multimedia are getting more closely related to daily life. Consequently, a phenomenal alteration is changing the environments surrounding as such as virtual workplace, virtual classroom, virtual library, virtual school and virtual community.

The basis for the implementation of the system will be an integration of existing technologies (multimedia systems, computer networks). Images, text, sound and video will be sent via the network to the users. But the development of the system requires more that a simple integration of existing technologies. The training has to be «on-line». This demand sets new standards for the system, creates research activities and tasks to be done and produces challenging demands for the implementation [Brunner 1995]. The services to be developed will be presented to the user through a friendly user interface [EU 1996]. From a technical point of view, these services can be classified into the following categories:

Basic services

- Teaching materials (course modules) can be sent to the users by e-mail. The updates would be sent over the Internet
- *Electronic-Mail-Service*: Among other things the users will be able to receive, transmit and draw messages and pass them to other users or groups. In addition to modify the teaching materials, teachers may store messages in the server.
- *Notice Board*: An electronic notice board its also offered on which the user can write messages and each of the participants can read them. This function allows an exchange of information and questions between the participants.
- *Electronic Questionnaire*: A list of questions to be answered by the users electronically will give important response for the tutor.
- *Question-Answer-Service*: With the electronic questionnaires the users can ask questions in multiple choice, which can be evaluated automatically by a process which calculate the score, based on the given answers. This service will help the user to control the learning process.

Advanced services

- *On-line communication*: This system will make possible a visual and acoustic communication between the students or between the tutor and remotely sited experts, by using an integrated camera in the PC and a microphone. This will activate tele-coaching and a virtual discussion in the teaching groups.
- *Screen Sharing*: The screens of the students and tutors or experts will be coupled. There will also be an acoustic connection via a telephone line. The tutor may put his screen on the monitor of the student and vice versa. So it is possible to go through an error analysis or to demonstrate alternative solutions, online and in a participative manner.
- *Catalogue Service*: There will be a catalogue service in the server with a digital library and extensive search possibilities.
- *Information Service*: At any time the user can achieve world wide thematic topic information with menu controlled links to external services and information sources.
- *Application Service*: With this application several students will have access to shared application programs, at the same time. This system is a necessary precondition for virtual partners, teamwork and for tutorial support.

The main technological challenge that we face during the development period of the system is the use of multimedia over the Internet [Encarnacao 1993]. Different network based multimedia platforms provide different types of audio devices and services. Nevertheless, all of them offer a common set of functionalities, such as record, store and playback. Online audio exchange for communication purposes was realised based upon these basic functionalities. In order to provide cross-platform usability, a common, intermediate exchange format was defined and a number of online bi-directional converters supporting different platform-dependent audio formats were implemented. Video communication for learning environments requires a fast codec algorithm that can be performed in real-time on either low-end hardware or by software. Since the real-time issues for video as a communication channel were more important than high quality pixel and color resolution we decided to use the JPEG (Joint Photographic Expert Group) codec standard for our video sequences, referred to as M-JPEG (Motion-JPEG). Within the system, a multipoint audio/video communication environment allows real-time discussions between groups of up to six teachers and students. Its control elements are embedded in the GLS application. Within the WWW, online communication is supported by using the M-Bone technology which is driven by the same idea of having people communicate in a more natural way.

Conclusions

In this paper we described our on going work on a Virtual Education System which enables on-line training courses in a collaborative manner using state of the art technologies. It enables a high level of instructor-student interaction using network, database and multimedia technology. It is designed by applying strict pedagogical principles so as to achieve the greater acceptance as an educational tool. We believe that the aspiration of Virtual Educational Systems will be further approached with this effort.

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Using a Template-Based Authoring System to Enhance Educator Control and Learner Performance

Vicki Jones
Jun H Jo
School of Information Technology
Griffith University, Qld 9726, Australia
{vicki.jones, j.jo}@maibox.gu.edu.au

Abstract: In this paper the development of structural learning environments for use over the Internet is discussed. Many educational programs are designed by specialist designers in consultation with educators. This can often be inconvenient, time-consuming and costly. The implications of this system will be discussed and a new template-based model proposed. With this new model the educator can be given more control over course structure, allowed easier modification of course material and have the option to embed teaching and learning strategies within the program. Ultimately, templates will be produced by multimedia designers and the educators, who use the templates to develop their educational programs, will then be able to work independently and at their own time, location and pace.

Introduction

Since automated teaching machines were first developed by Sidney Pressey in the 1920's (Sloffer, 1995), the development of educational programs has steadily advanced. The progress followed on from those early teaching machines, Eastman's educational films of the late 1920's (McReynolds, 1995), military training films (Shlechter, 1991), computer-based instruction (Reeves, 1991), interactive multimedia (Jones, 1998) to the current and wide-spread use of the Internet and the World Wide Web for educational purposes (McManus, 1996). Increasingly, the Internet is being used as a vehicle for delivery of educational material. This can be of particular relevance in the field of distance education (Carswell, 1997). Today it is possible for a student to complete an entire degree course through this medium.

Currently, design of Internet-based educational programs is often produced by a "project team", which consists of multimedia designers, a coordinator and the educator(s). The project team will use a set framework as the basis for design, producing a number of pages with common attributes. A good layout will incorporate consistent design features which include:

- buttons and entry/exit points which retain page position
- constant background pattern or colour
- uniform menu items

In this way the program can retain a user-friendly quality. The user has fewer navigational problems and is not required to learn new navigational skills for each page, section, lesson or subject.

In this paper, the focus is on the design of templates for Internet-based educational programs which allow for the incorporation of teaching and learning strategies, often overlooked by more conventional methods. A new template model, which applies the ideas put forward in this paper, is presented and discussed.

Templates in Internet-based Educational Programs

Templates have been used across a broad spectrum of applications and fields of study for many years. A template is basically a model of some type, which allows the user to add individual design features. Many people will be familiar with the plastic templates used to prepare programming flowcharts, chemical diagrams and geographical maps. More recently, word-processing templates have emerged. These templates provide a pre-delineated area to be filled out in order to complete a document. Apart from computer-based templates, there are many other types made of a variety of materials for use in a wide range of applications. The important thing to remember, and the unifying quality of a template, is that it is a "pattern" and it is "reusable" (Chia, 1996).

Templates can offer the same basic elements of design as provided by the project-team "set framework" approach. Pages can be produced with common attributes incorporating the consistent design features of buttons which retain page position, constant background pattern or colour and uniform menu items. In addition, when using the template method, the educator is able to both create and design the instructional program to be delivered via the Internet, leading to higher productivity and more efficient time management and cost expenditure (Jo & Jones, 1998). Current aspects of template use include uniform formatting, reuse of materials, easy modification and flexibility (Rebelsky, 1997). Much of the current template research and development results in interactive courseware products, such as CourseWeaver (Rebelsky, 1997), ASML: Web Authoring (Owen & Makedon, 1997) and DISCourse (Mispelkamp & Sarti, 1994). These template-based programs have many advantages, yet there is a tendency to concentrate on development from the designer's perspective rather than that of the novice user.

Incorporation of Teaching and Learning Strategies

The current approaches to template-based design may satisfy the needs for design simplification, clarity, cost effectiveness and time efficiency. However, the enhancement of learning performance, a crucial aspect of effective teaching, appears to take low priority. The issue of interactivity is also often overlooked. Interactivity helps the student remain focused and interested in the subject. A student-centred approach based on the learning theories of behaviourism and cognitivism, should play a significant role in the preparation of any educational multimedia product (Jones & Jo, 1998a). People tend to learn initially by behavioural methods. As they start to recognise strategies and patterns, cognitive skills are established (Lefrancois, 1988). It is interesting to note that Pressey's teaching machines, although primitive, incorporated the theory of behaviourism, using the stimulus-response method of teaching.

The fundamental principles of behaviourism can be implemented using the stimulus-response-reinforcement process. This does, of course, depend on the target audience, age group being an important factor. The subject and purpose of the lesson should also be considered. For a young target audience, the use of stimulus-response-reinforcement can be useful in obtaining and keeping the students' attention, whereas, for an older group it is perhaps more suitable to be used only in the feedback section of the course. Various stimuli, such as visual and audio prompts, can instigate a response from the user and suitable positive or negative reinforcement can be initiated. This may be in the form of a reward or remark, such as a pop-up comment, an offer to continue into the next phase of the lesson, or relevant links to other pages that may help with student understanding.

In an educational computer program, as in everyday life, users are at an advantage if they are able to apply previous knowledge. In this way they are using their cognitive skills (Lefrancois, 1988), as well as constructivism by forming new knowledge from the learning experience (McMahon, 1997). The processes used include recognition, perception and information processing. This is initiated by using "reminders" in the form of different coloured text, video clips or visual prompts to remind, represent or clarify certain points, and incorporating quizzes into the feedback structure. It is the belief of the authors that these approaches should be considered when designing templates.

Incorporation of teaching and learning strategies within the template can be achieved by embedding visual and audio prompts, time-out detectors, and a variety of user options, such as colour specifications. The techniques used are implemented by using HTML, DHTML, JavaScript and CGI scripts.

Template-based Educational Model

A number of templates may be necessary to suit the many and varied fields of study and age groups. The templates, designed by professional multimedia designers, need only be designed once thus reducing the cost of production. The educator, who uses the template for web page design, can enter course content material through a Web browser, then review and refine the program as it develops, making the whole process user-friendly and flexible. The educator is provided with more control as the program can also be modified or extra lessons added at a later date. The entire design process is represented in (Figure 1).

Figure 1 represents the step by step processes involved. The multimedia designer produces the design library. This large storage component comprises the designed templates held in the template library and an audio/video database. The multimedia designer has access to both the design library and the Web page generator for creation, maintenance and technical support purposes. When educators use the program, a template is retrieved along with any audio/video material they select for inclusion. They are guided through the design process in easy to follow steps, with various options including a default selection. Once the design process is complete the educators can store their design in their own personal design database for later use and modification. This only requires a limited storage capacity as specified by the designer on current context and preferences.

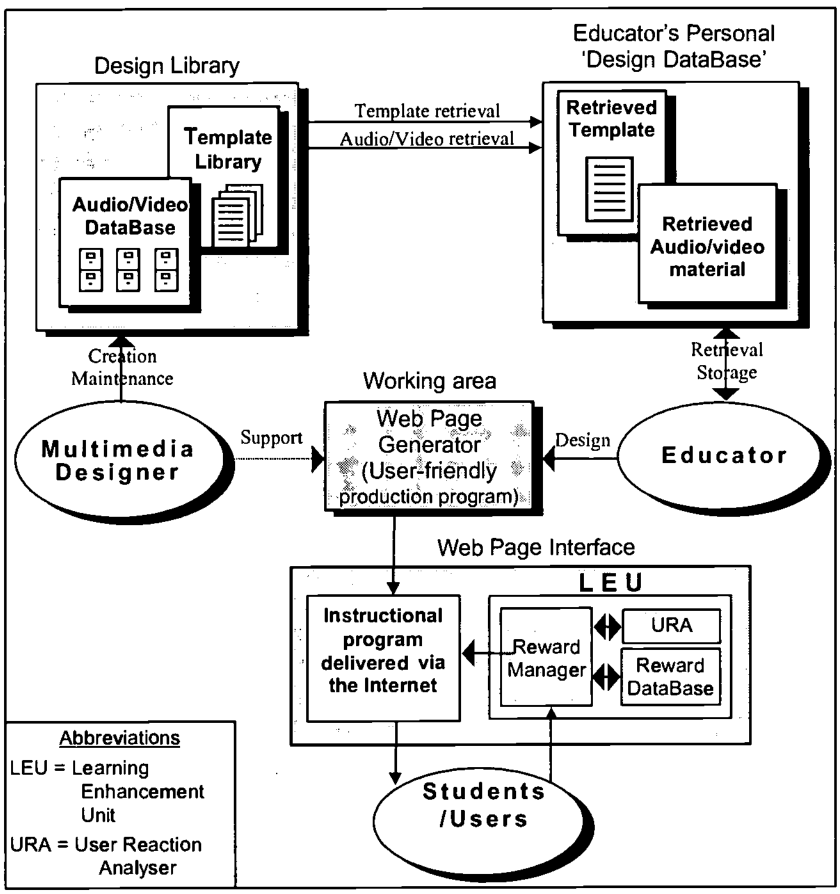

Figure 1. Template Model

The Learning Enhancement Unit (LEU) is an important factor in offering the student an interactive environment which applies teaching and learning strategies. The User Reaction Analyser (URA) is used to evaluate student performance. The Reward Manager receives input from the student/user and forwards this to the URA, a specially designed system which uses a series of "if ... then" statements to produce a range of suggested rewards or prompts. The Reward Manager draws a suitable reward, either positive or negative, from the Reward Database, and implements a reaction within the Web page (Jones & Jo, 1998b)

Issues that could be detected by this system include student comprehension, habits and preferences, as well as physical issues of hearing and vision. For example, the screen colour may cause difficulty for a colour-blind student. Other events include time-out detectors and question-answer analysers which detect the need for feedback to the student. The multimedia-based Reward Manager and Reward Database work hand-in-hand in determining and dispensing appropriate reinforcement. This includes positive and negative support, in the form of bonuses, penalties and encouragement or deterrents. The reward system functions by using pop-up remarks, visual displays, sound alerts, appraisals or the offer of a brief game or new links to other pages.

Conclusion

The template-based model for producing educational programs has been designed and developed using HTML, DHTML and JavaScript Web languages. The template itself consists of a series of easy to navigate web pages which guide the user through the design process offering many options. It is easy to use, especially for the novice user as no programming experience is necessary or assumed. As the program is written in Web languages, the pages appear similar to any web page and are just as easy to use.

With this model, educators work independently at their own time and pace. They are provided with the means to design, produce and modify their own instructional programs thus relevant teaching and learning strategies may easily be incorporated within a common design. This gives educators greater control over course presentation and learner performance. Using a template, the educator can effectively become the creator of an individualised learning tool.

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Restructured, reengineered & realigned: Managing media in the digital age

Ian Hart
Centre for the Advancement of University Teaching, The University of Hong Kong. Hong Kong
ianhart@hkusua.hku.hk

Abstract
Information technology (IT) is critical to the future success of universities. Those universities that succeed in integrating IT will attract students and resources; those that get it wrong will suffer financial and structural difficulties. Any management scheme for IT in a university needs to balance five key factors: Strategy, Structure, Management processes, Roles and skills and Technology. Successful universities exhibit a high level of fit among these five factors. A poor fit means that a university is not functioning in a cost-efficient with respect to IT. Most universities have developed some form of educational technology support structure centred on a media unit, computing service or library. The paper concludes by describing three approaches to the management of IT support: a distributed approach (old universities) integrated approach (new universities) and parallel approach (divisional universities)

Engines for change

Technology is inexorably changing higher education as we move into the digital age of the third millennium (Negroponte, 1995). Of course technology is not the only factor at work here, but is one of many forces, and they are all inter-related.

Mass tertiary education.

In the 1950s and 1960s in most developed countries 8-10% of schools leavers went to university; in the 1990s the figure is closer to 40%. This has two consequences

- These students can't all go to the 'old' universities which have dominated the field for the past 100 or more years; new universities have been established to meet the needs of mass education
- Universities differ in quality: some new universities have developed niche positions and specialisations in non-traditional or cross-disciplinary fields; others are more like American 3-year colleges.
- Distance and flexible learning is attracting non-traditional students.

Learning theory

The past decade has seen a noticeable shift in learning theory from 'top-down' instruction-based teaching to a focus on the individual student's construction of knowledge. This is evidenced in changing curriculum structures such as Problem-Based Learning, Flexible Learning, educational multimedia and Web-based teaching.

Technological imperative

In a period of 10 years there has been a revolution in information and communication technologies that has affected almost every area of life, not the least education. Some of its manifestations have been:

- A convergence of technologies whereby different and distinct media such as print, video, graphics, photography and audio have converged into a single technology, multimedia.
- An information explosion, whereby an Internet user with affordable equipment can gain access to exponentially increasing volumes of information.
- The cost-performance ratio of IT has improved dramatically with technologies such as CD-ROM and the WWW, which enable flexible delivery.

Economic view of IT

Clark & Sugrue (1995) identify economics, particularly cost-benefit, as a driving force behind the adoption of IT in education. The arguments can be summarised as:

- New technologies promise the possibilities of new strategic advantages:
- Shift from the constraints of place to the freedom of space: learn anywhere, any time.
- Shift from focus on teaching by lecturer to learning by the student

New paradigms for higher education
New paradigms have arisen. The following table is an amalgam of many dichotomies found on the World Wide Web:

	Old	New
System	Take what you can get	Courses on demand
	Academic calendar	Year-round operations
	Terminal degree	Lifelong learning
Students	Students are 18-25	Cradle to grave
	Student as a burden	Student as a customer
	A 4 years revenue source	Lifelong revenue source
Learning	Books are primary medium	Information on demand
	Listen & learn	Solve problems
Teaching	Single product	Information reuse
	Delivery in a classroom	Delivery anywhere
	Single discipline	Multi-discipline
Faculty	Tenure	Market value
	Research is priority	Teaching is assessed
	Responsible for content	Part of a team
Funding	Government funded	Market funded
	Competition is other universities	Competition is everywhere
	Technology an expense	Technology as differentiation
Culture	University as a "city"	University as an idea
	Bricks and mortar	Bits and bytes
	Multi-cultural	Global
	Institution centric	Market centric
	University as ivory tower	University as partner in business

Table 1

Impediments to change

Not everyone agrees with this recent and sudden move towards IT and education. Universities, more than most organisations, value tradition and are institutionally resistant to sudden change. In most universities it is easy to observe an ongoing struggle between advocates of university tradition and of the new technologies.

Conservatism
Universities, even the new ones, act as if they are part of a long tradition going back to the early universities of Europe (gowns, ceremonies, arcane by-laws, titles, etc.) In this sense, universities are appropriately conservative and students value the traditions they conserve. In contrast, IT strategic planning often advocates major change in the delivery or form of education. The guardians of a university's reputation may, and probably should, resist such changes until they are convinced that this is not a flash in the pan.

Culture
Not everyone in a university shares the same culture. This is true in particular for technology specialists and academics. They have very different experiences and each often sees the other as uninformed.

- Academics typically have long formal training, 8-10 years for a PhD (12-15 years for a *habilitation* in Europe) and, frequently, little experience outside higher education.
- Technology specialists often have less formal training (but not necessarily less training) and typically have experience in a number of different industries but may not fully understand the university's culture.

IT Management

Rapid changes in IT and in the higher education sectors generally have stimulated changes in IT management processes. In some cases these changes have provoked knee-jerk reactions or have been grist to the mills of internal power plays: media centres have been closed, or moved into/out of the library or amalgamated under a central body.

In most university Senate debates and discussion papers about the role of IT there are a number of common key questions:

- Who owns IT?
- Where should it sit in a university structure?
- How do we get the cost benefits of centralisation as well as the value-added benefits of devolution and user control?
- Should IT report to Administration or to a PVC (Academic) along with other teaching and learning units?
- Is the head of Flexible Learning (an educator) at the same level as the head of IT (a technologist)?
- Should training about teaching and learning technologies be in the academic professional development unit or in Information Services?
- Should the professional development unit be in a faculty or in central administration?

Planning change - the MIT90 Model

Reflecting the new paradigms set out in Table 1, many universities are turning to business models in order to restructure their management, curriculum and communications. The four diagrams below illustrate variations of what is known as the MIT90 model, developed by Scott Morton (1991), and quoted by Yetton (1997) in an important paper on managing technology in higher education commissioned by the Australian Government.

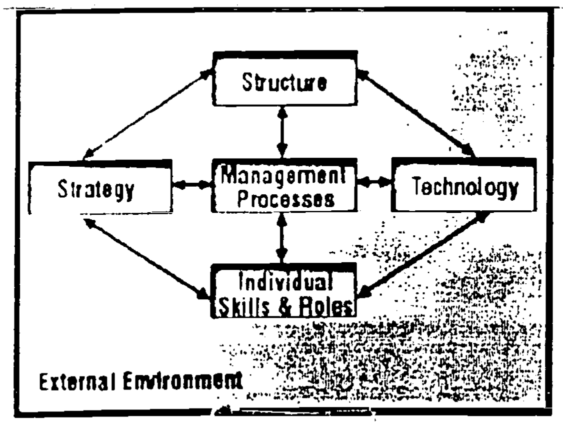

Figure 1

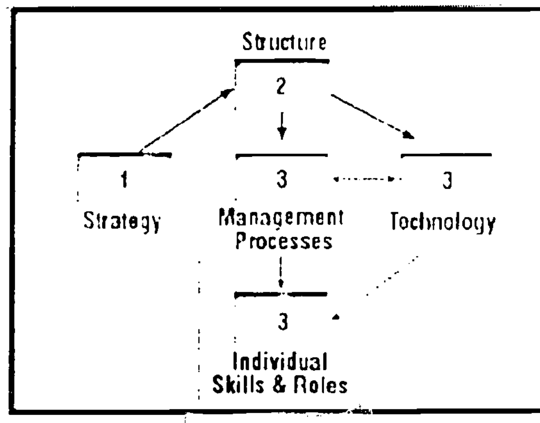

Figure 2

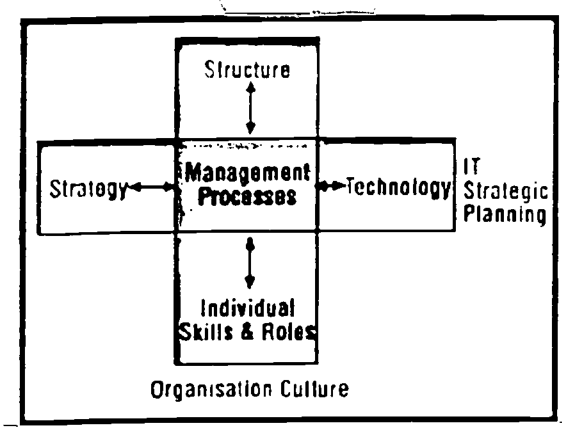

Figure 3

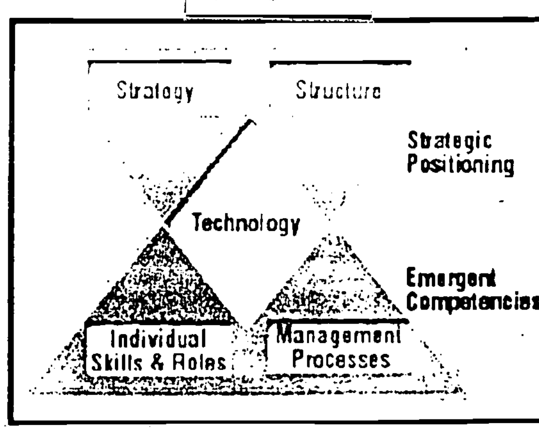

Figure 4

Strategic fit (Figure 1)

Yetton notes that successful organisations exhibit a high level of fit among five factors: strategy, structure, management processes, roles & skills, and technology. "It is a principal task of management to attain and sustain a high level of fit and, when strategic change occurs, to re-establish fit, and therefore high performance as soon as possible" (p.2).

Organisations in strategic fit have four characteristics.

1. The effective integration of strategy, structure, management processes, technology and roles/skills creates a focused organisational gestalt which simplifies formerly complex organisational and management demands.
2. This simplicity fosters clarity of understanding within the organisation, which reinforces and sustains fit. This means that the organisational structures, management processes (such as reward and control systems), and key technologies combine to support the strategic intent, as well as shaping the required task focus and behaviour of managers and employees.
3. Simplicity reduces the need for elaborate and complex coordinating mechanisms; thereby freeing up resources which can be focused on value-generating activities.
4. The high levels of performance created by this strategic fit serve to reinforce the process by which it is attained, and thus further simplify the fit among the elements of the organisational gestalt.

Such a tight fit, both internally among the elements of the organisation and externally with its environment, is associated with high performance.

Top down management (Figure 2)

In a time of change, when the balance between these factors has been altered (as described above, for example), how do we go about re-establishing fit? The most common method is to view strategic change as a three-step process, driven by a top down strategic positioning perspective.

1. A new strategy is identified and adopted.
2. The organisation is restructured to support that strategy.
3. The IT strategy and the management processes are redefined and aligned to the organisational strategy and human resources trained in these new skills as required.

This conventional, rational model of strategic change assumes that successful change is the result of a formal process of strategic planning, in which IT is aligned to the dominant strategic design. In line with business organisations in other fields, many universities have explicitly adopted this top down positioning model of IT-based strategic change. The most common outcome of this approach has been the drastic restructuring, or in some cases the dismantling, of existing educational technology services and the creation of an entirely new grouping, independent of teaching departments. Its mission is to speed up the employment of IT in teaching and management but it often meets resistance from areas of the university which have not been restructured.

Strategy vs. culture (Figure 3)

The MIT90 schema clarifies one of the common problems of strategic change with technology, when the impediments to change, mentioned above, come into conflict with the vision of university management. In Figure 3, strategic IT planning is the horizontal arm to the cross. When the organisation culture, the vertical post of the cross, is compatible with the implicit assumptions of IT strategic planning, there is close fit and few impediments to the realisation of the strategy.

Unfortunately, existing university culture is frequently not supportive of IT strategic planning. So as the university implements its change, it shifts out of fit and performance drops off. Unless it can bring its culture into fit quickly, then performance loss is likely to stall the change initiative.

Technology as the driver (Figure 4)

If we redraw the MIT90s framework to show IT at the centre of the five elements, we can visualise IT's role in both top down and bottom up management of change. The diagram shows two triangles illustrating the top down and bottom up dimensions.

Much IT-based strategic change involves altering the competencies of the organisation, and these are found in the bottom triangle. So as well as considering the organisation's strategic position (the top triangle), change requires careful attention to reconfiguring the bottom triangle. In fact an integrated top down and bottom up management of IT-based change is required (Craig & Yetton 1997).

Staff roles & skills

Of the five factors described in the models, the most contentious for academic staff is the requirement for change in "Individual Roles & Skills".

- Teachers need to have more theoretically grounded pedagogical knowledge, so that they can manage and direct projects using IT for creating resources and facilitating processes, otherwise they may come to regard technology as a panacea.
- In the new media of network based learning the teacher is not the primary source of content, but rather a resource person with content expertise. There is a shift in the 'power balance' between teacher and student. The use of contact time is more determined by student needs than teacher's agenda.
- Academic staff may take up technical roles related to media production (interface design, graphic design, instructional design, storyboarding, programming, media selection, file conversion etc.); there will be a greater emphasis on process design for teaching and increased emphasis on the roles associated with the development of distance materials.
- IT experienced staff need to be recruited as staff developers and trainers with respect to their colleagues in relation to communicating innovative practices and assisting colleagues to learn the skills required to use IT in their teaching
- More and different 'basic skills' are required for academic work. Teaching roles are becoming more information technology intensive, with demands for straight technical knowledge and skills increasing: word processing, presentation software, project planning, programming, graphics, sound and video are among the areas coming into contention for inclusion in the core skill sets of teachers.
- Academics are being required to take on increased administrative work with developments in networked administrative systems. Central data entry and report generation in areas like student administration are being devolved to Faculties and Schools, and some of this work, once done by administrative staff, is being taken up by academic staff.
- Heads of Schools who once understood the technologies of teaching (blackboards, classrooms and laboratories) are now required to make decisions about curriculum developments and equipment purchases with significant information technology components.
- The information technology component of work is increasing in all areas, and managers are also having to make decisions about the development, funding and maintenance of information technology intensive activities, often with a less than perfect grasp of the technical details involved.

Costs of production

A primary change brought about by Technology is the cost equation of producing and utilising new media materials:

- Universities are not accustomed to paying for the development of curriculum and teaching materials. Content and quality are typically seen as the private responsibility of teaching staff. Teaching materials are rarely considered to be university property.
- The use of IT-based teaching resources and processes demands much higher 'production values' than is the case for lecture notes and paper handouts - more staff and staff time in development, and the use of a range of production services.
- The process of recognising the true costs of teaching with technology based resources and processes, and of funding it appropriately, involves shifting the issue from the private concern of teachers to the concern of the institution.
- This shift has cultural, industrial relations and legal implications, all of which will have to be addressed.

Three models of IT management

We do not need to conclude that one of the approaches described above is right and the others wrong, in which case the task would be to discover the best approach. Rather, we can assume that each university will attempt to develop a different approach, based on some combination of the above models of change, to discover a new effective fit, and to satisfy its stakeholders' needs. The success of the approach adopted by a university will in part be contingent upon the fit with its current resource position, history and capabilities, as well as how effective it is in successfully differentiating itself and embedding the required strategic change in the organisation.

Old universities

Until comparatively recent times university education was an elite activity and the older universities offered degrees dominating the high status professions of medicine, law and engineering. These universities are located in or near the CBDs of capital cities and have long traditions of scholarship, endowments and research. Many of society's leaders are graduates of these universities.

IT Strategy

- A *distributed approach* with responsibility for IT-based teaching and learning developments devolved to local innovators across a range of faculties and units
- IT is used to enrich the old university's elite community.
- Concentration on maintaining the established base while funding independent new ventures.
- Successful ventures feed the established university community with their innovations in teaching, learning & research.
- Entrepreneurial ventures have the ability to select expertise with few constraints such as terms and conditions of employment.
- Attracts high status academic risk takers and innovators.

New universities
Many began life as polytechnics or specialised institutes and have recently been 'promoted' to university status; some have been created from scratch. There is little if any tradition of research and the emphasis is on establishing a reputation for teaching excellence, employment-oriented courses and quality facilities.

IT Strategy

- An *integrated approach* with a central unit managing the integration of teaching and learning with IT, emphasising support for professional development in educational and information technologies and linking it to university goals.
- IT is central to and critically underpins the strategic agenda.
- IT enabled teaching & learning is designed to deliver quality and reliability to a large number of students.
- Highly skilled experts in production and technology are recruited as required.

Divisional universities
Typically large and devolved, often an amalgamation of a number of institutions with multiple campuses and a high degree of specialisation in strong academic faculties. There is a strong emphasis on applied research and collaboration with industry, particularly in disciplines such as Engineering, Business, Health and Education.

IT strategy

- A hybrid, strategy that uses IT to obtain benefits of a low cost central IT infrastructure, while empowering innovation and student focus in strong academic faculties.
- Devolved faculties enabled by a powerful IT central infrastructure each has different competencies and strategic foci; each division has its own IT support and develops its own appropriate set of technologies, management processes, skills & roles.
- Focus on each division's core competencies in particular areas of applied research & teaching

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Remote Lecture Presentation Preferences for Internet Delivered Continuing Medical Education

Sylvia Willie
Faculty of Information Technology
Queensland University of Technology
AUSTRALIA
s.willie@fit.qut.edu.au

Celeste Ng See Pui
Tunku Abdul Rahman College
MALAYSIA
ngsp_1534@tarc.edu.my

Dr. TE Allan Palmer
AUSTRALIA
Allan@palmer.net.au

Abstract: Internet delivered Continuing Medical Education (ICME) is a new learning mode for medical practitioners. This technique allows the delivery of CME material via the Internet, using the World Wide Web, regardless of geographic location. This paper reports a case study of GasBone, an early adopter and innovator in ICME. The Introduction describes the users and their characteristics, the educational goals addressed by the ICME project, GasBone, and the issues addressed by this paper. Study Methodology describes logfile and questionnaire methodologies together with a description of the different presentation methods included in the GasBone project. The third part discusses the findings from the logfile analyses and questionnaire results relating to ICME lecture presentations. Finally the results, conclusions and recommendations for organisations implementing remote delivery via the WWW are discussed.

Introduction

Medicine requires its practitioners to update their knowledge and skills on a continuing basis in order to maintain a license to practice. Continuing Medical Education (CME) is a term used to encompass the process of lifelong learning following initial graduation from medical school. Traditional delivery modes for CME include self-directed reading of journals and books together with attendance at conferences, courses and lectures. Access to group CME events are frequently limited by geographical isolation and/or the need to maintain medical services to the local community.

Medical practitioners have always undertaken CME activities but the pace of change now limits the effectiveness of traditional practices. The advent of the World Wide Web and ICME provides an important additional access to delivery that may solve some of the problems of geographical isolation and inequity of access.

The on-line environment is different from the traditional style of lecture. The learner can read the lecture anytime and anywhere as long as they have a computer modem and Internet connection. Even though in early 1998 Internet CME is still in its infancy, it may become the most common and convenient CME learning mode in the future. As an example, Malaysia, a developing country, has already planned to implement Internet CME under the Flagship of Telemedicine in its Multimedia Super Corridor (MSC) project. The relevance of this research into Internet CME and its potential for future development is high.

Suggs, Rose and Mittelmark (1993, 149) see CME not as a supplementary service to health professionals but as a necessity. The professional development of health care personnel is crucial as they have to adapt to the rapid (even daily) changes in knowledge generated by research and the technological advances made in medicine. Wallace (in Suggs, Rose and Mittelmark, 1993) lays the responsibility on the professions to improve and enhance the existing knowledge and pass it on to the coming generation. Miller, et al. (1997, 760) and Carney et al. (1995, 52) are in agreement that CME is designed to improve quality, knowledge and skills in order to maintain the competence and capabilities of physicians.

This case study examines the GasBone web project, an ICME site that specializes in the delivery of CME in the medical subspecialty of Anaesthesia. We wish to determine which formats and modalities of ICME are preferred by medical audiences. Both retrospective log file analysis and prospective questionnaire were performed during the study which was conducted over an 8-month period from late 1997 until mid 1998. Web server logfiles were analyzed covering the period June 1996 to November 1997.

In this research, GasBone, a project of the Division of Anaesthesiology & Intensive Care of the University of Queensland, Brisbane in Australia, was investigated as an example of ICME. This project was originally conceived as a way of linking geographically separate centers in a statewide medical department but grew into a major facility for the provision of CME for the international medical community. By late 1997 the GasBone project had been in use for CME and undergraduate medical teaching for 3.5 years (Palmer 1996a, 1996b).

GasBone provides a library of WWW/Internet lectures, presented in real time video, lecture slides with audio, lecture slides, graphic images and/or plain text page. This CME web site provides educational material specifically for specialist anaesthetists, anaesthetist trainees and GPs who practise anaesthesia. The GasBone project was a proof of concept project rather than a fully funded research project so new lectures were added as funding became available during the period under study.

The GasBone project includes 42 on line CME lectures in various formats including: text based web pages (19); text based slides (10); video only (6); text slides with sound track (3); slides with video (2); and text slides with audio and some video (2).

These lectures target various knowledge levels. Two thirds of the lectures are anaesthetic CME for practising anaesthetists and trainee anaesthetists. The other third of the lectures target undergraduate medicine and pre-medicine students.

The GasBone project was an early adopter of streaming video on the WWW with a VDO server installed in 1996. The web server and video server are separate software programs running on a common hardware platform (Pentium120, 128MB Memory, Freebsd2.2). User requests for video are processed by the web server but actual delivery of video is handled by the video server. The server has a permanent connection to the Internet via the University of Queensland network.

Study methodology

This case study uses both retrospective analysis of Web server log files and prospective mail questionnaire. Server log files will include data from all users, both local and international (Ng, 1998,4-4) and may also include a proportion of traffic from non-medical users. The mail questionnaire was however directed to all specialist and non-specialist anaesthesiologist trainees in Queensland, Australia The log file analysis gathered data on the monthly hit rate for five modes of CME presentation. Text only; plain text with graphical illustration; graphical slides with a sound track; slides with sound and video and video only. Data was collected for the monthly 'hits' data for the first page of a set of lectures from the time they became available until the end of the study period for all the presentation types available.

The mail questionnaire was sent to the 1041 specialist anaesthetists, anaesthetist trainees, and rural and remote practising GPs who also perform anaesthesia. These practitioners comprise the GasBone target group living in Queensland. Responses were received from 32% (332) of the target group. Only 19% (63) of them had participated in Internet CME at the time of our survey (February 1998).

We asked respondents to rank their preference for the following seven presentation types.

1. *Series of 20 slides from a lecture*: a linear online / Internet lecture, presented in the form of images similar to a PowerPoint presentation or a set of transparencies. The user can browse serially from one slide to another by using a mouse to click on either the previous or next button at the bottom of each slide.
2. *Sequence of 5 slides from a lecture*: same format as (1) except for much shorter series of slides.

3. *Slides with sound track*: an online lecture usually presented as just 1 slide with the speaker's voice recorded. Text is minimal.
4. *Slides with sound and video*: an online lecture presented in the form of slides with embedded sound and video. There are usually a number of slides for this type of lecture. Each slide has its own sound and video The user must install VDO plug-in software in order to view this type of lecture.
5. *Plain text only*: an online lecture presented as a web page with only text. The text is often in only one file but there is no indication of length aside from the scroll button included with the browser. The user browses through the whole lecture by using the mouse or arrow keys.
6. *Plain text with at least half pictures*: this online lecture is similar to plain text only lecture except almost half of the lecture is presented in the form of static graphics or pictures.
7. *Video only*: an online pure streamed video in which a lecture is presented in the form of a motion picture but with a quarter screen picture and very slow frame rate. This type of lecture also needs the VDO software plug-in installed in order to view it.

What Kind of Lecture Presentation Keeps Users' Interest?

Presenting web based learning materials is of little use if users do not or cannot access them. Disuse stems from a variety of problems such as slow modem lines, boring material, overly long sequences of material, the need for plug ins before the material can be used, sound either alone or with video that is indistinct or unintelligible, even content that is inappropriate to the user's learning needs.

The questionnaire provided data on respondent's subjective preferences for the seven types of lecture presentation on the Internet. Note however that less than 22% had direct experience of an ICME presentation. To gauge the difference between preferred information delivery method and the current practicalities of Internet CME this data was analysed separately for respondents with and without Internet CME experience, (Tab. 1).

Types of presentation	Rank (all respondents)	Rank (ICME experienced)
Slides with Sound and Video	1	2
Slides with Sound Track	2	1
Plain Text with Lots of Pictures	3	3
Video Only	4	7
A Series of 20 Slides from a Lecture	5	4
A Sequence of 5 Slides from a Lecture	6	5
Plain Text Only	7	6

Table 1: Comparison of rankings of Internet lecture presentations between all respondents and those with ICME experience.

Sound, video and pictures rank highly when the whole group of respondents is considered, but video drops in rank among those with ICME experience. We can see from the second column that Video Only, without the accompanying slides, was least preferred by this group. Video quality off the Web is still not good enough in comparison to television or even home video. The network bandwidth and currently available technology causes the download time to be lengthy, often exceeding user's patience.

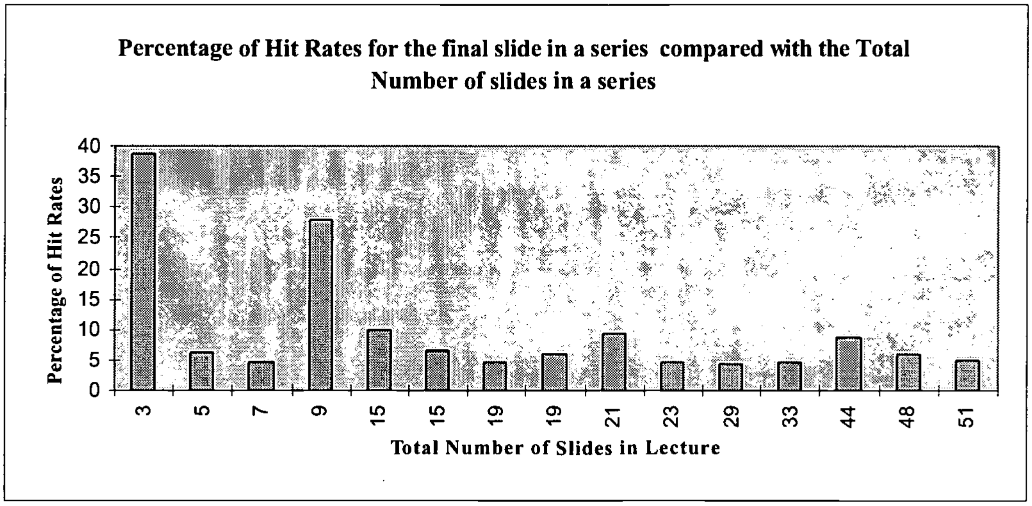

Figure 1: Retention of user interest by number of slides in the presentation.

Figure 1 plots the percentage of hits for the final slide in relation to hits for the first slide. The total number of slides in each presentation varies from 3 to 51. The graph clearly indicates the decline in retention of users as the total number of slides increases from 3 (39%) to 15 (10%) For lectures which consisted of more than 15 slides retention was generally well below 10% and fell as low as 5%.

The anomalies were those with content of particular interest (for example the total slides of 21, "Preoperative Assessment of Dental Patients", and 44, "Electronic Access to Medical Education") or those which contained elements which had slow load times (total slides of 5 and 7 are lectures presented as segmented video and requiring the user to have plug-in video software in order to start the lectures). Thus content and accessibility appear unsurprisingly to affect retention.

Comparing log file data for plain text and graphic intense pages, we found there was very little difference in the access rates for the two presentation methods. This seems to indicate that well chosen and sized graphics does not preclude user acceptance.

When the hit rates for plain text were compared with video pages we expected, but did not see a significant difference. However this may be spurious as Internet video was a technical novelty at the time of the study period and GasBone was an early adopter. The video requests may therefore have been high during the first few months of availability due to interest in the technology rather than the content. More recent feedback from the target audience indicates Internet video delivery is not as successful as a hybrid delivery that places the video on CD-ROM with dynamic links to the web site for updates.

Ten Months average hits for the six types of Internet lecture presentation

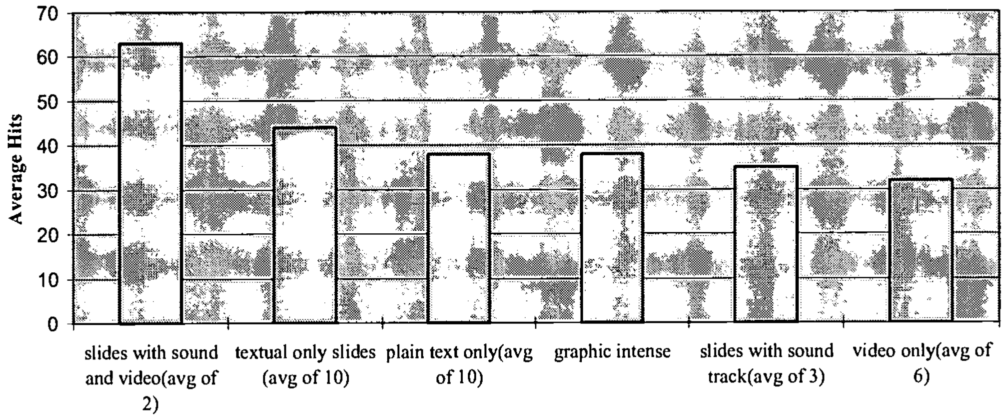

Figure 2: Average monthly hit rate by type of Internet lecture presentation

Figure 2 presents the average monthly hit rate for each type of presentation. It can be seen that slides with audio and video had a higher average monthly hit rate than any other presentation type. We believe that slides with media provide textual backup to the video or audio that augments the user's comprehension.

Slides with audio and video had the highest average hits in the log file data depicted in Figure 2 but ranked second among the ICME experienced respondents in Table 1. Appropriate use of video with audio is thus not just a curiosity, although the higher hit rates shown above can be partly attributed to the novelty factor.

Conclusions and Recommendations

The nature of the GasBone project presents challenges to data analysis. Materials were placed on the Web as they could be made available. As an early adopter of streaming video on the WWW, the developers experimented with video presenters, styles of presentation and modes of delivery. The apparent advantage of integrating video and audio into an otherwise textual slide that orients the user was indicated in this study and has proved successful in the longer term. Log file data is 'noisy' by nature and in the case of publicly available Internet delivered learning materials does not necessarily represent relative preference by the target audience.

In the interest of achieving a high volume feedback from the questionnaire, we felt that difference between perceived choice and what is viable and usable over current (particularly remote) WWW delivery was not fully reflected in the data gathered. Indications of reality emerged, however, from separate analysis of the responses of those who had participated in ICME.

In sparsely settled areas of Queensland, modem speeds were achieving no better than 14.4 kb/s at the time of this survey. The content of a streaming video would have to be outstanding before busy people like medical practitioners would be willing to wait for it to download. However, as indicated earlier, more recent efforts have shown hybrid delivery using a CD-ROM for video delivery to be viable. Slides with sound and video are another alternative and were more frequently requested than were the video only pages. There is a definite interest in video and one must monitor advances in these technologies that may allow wider delivery of useful video.

It is also important to honour the user's comfort zone. Medical practitioners are accustomed to learning from text. Providing long textual pages that can be downloaded in one hit for local printing are a useful delivery mechanism for this target group. Moving decorations are much less of interest, particularly with the bandwidth restrictions. However, well chosen and clearly laid out graphics can provide useful explanatory power.

While a broader group was not sampled in this study, similar results would be expected where the user population was well educated and in a profession where continuing education is required to maintain accreditation. Inferences about the problems inherent with remotely delivering complex materials can also be made. Further study would be beneficial to track whether the rapid uptake in Internet participation is extending into sparsely settled areas without the higher bandwidth found in urban centres.

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Writing on the Web: Technology and Implications

Alan Amory
Biological Pedagogics Research Unit, School of Life and Environmental Sciences,
University of Natal, Durban 4041, South Africa.
E-mail: amory@biology.und.ac.za

Abstract: The Web is argued to be the next great technological tool to be used in the delivery of educational materials. The success of virtual classrooms will depend on a number of issues including pedagogy and the appropriate exploitation of technology. This paper describes the building of a Web site and experiences in using such a site, to support collaborative learning between students, experts and the course co-ordinator. Active Server Pages and database technology running on Microsoft Internet Information Server was used to create the system. Students wrote assignments on the Web that were reviewed by peers, experts and course co-ordinator. The course, based on modern educational principles, was found engaging by the students but was under-utilised by the peer and export groups. Also, the use of the Internet as a mechanism to stimulate open discussion appears to change the way in which papers are written and reviewed.

Introduction

The use of the World Wide Web as a mechanism to create virtual learning environments and to deliver other educational resources (such as lecture notes) is heralded as the next great educational tool that will solve many problems and make education cheaper and more accessible to a larger community. It is often argued that the World Wide Web can facilitate learning as the technology allows the easy integration of many disparate forms of media and communication technologies into a single delivery mechanism (Dwyer, Barbieri, & Doerr, 1995). During the past few years there has also been an explosion of the use of "Virtual Classrooms". However, Winn (1998) argues that "simply converting traditional university courses to web pages, or worse, just putting lecture notes on a Web page, is a serious mistake". A search using Infoseek (www.infoseek.com) with the key word "virtual classroom" returned 13 390 hits. Many of these relate to the use of the technology and not on the use of appropriate learning theories to support the development and deployment of virtual classrooms. Ryder (1996) argues that "the challenge for the postmodern educator is to discover the capabilities and natural constraints associated with distributed pedagogy for scaffolding learners in the age of information".

Alexander (1996) argued that the Web could be used as a platform for course delivery as hyperlinks closely map to the structure of the knowledge that it represents (see Kearsley, 1988), allows interactivity and collaborative authoring of content, and also integrate the learning experience. However, that authors also contends that new adopters of technology often concentrate on the technology and not on the learning. Presentation of content is insufficiency to promote learning (Winn, 1998).

In an extensive study, Saljo (1979) found that learning can be divided into five categories that include, quantitative increase in knowledge, memorisation, skill and methodological acquisition, making sense or abstraction of idea and interpretation and understanding of concepts. Schank & Cleary (1995) argue that teaching frameworks for learning should include simulation, incidental learning, reflection, exploration and include case-based scenarios. Constructivists argue that knowledge and understanding are actively constructed by the learner, not passively received from the environment, and socially constructed through experience with the physical world and social interactions leading to consensus (Piaget 1929, Ausubel 1968, 1977, Vygotsky 1978, Driver & Erickson 1983, von Glasersfeld 1989).

The use of Internet and database technologies allow for the easy development of resources where learners can easily create Web-based content, critically evaluate the submissions of other students and interact using discussion fora. However, the sociological effect of creating public content is not clearly understood.

In this paper I will describe a system that was created to teach a fourth year biology course where students investigated topics and reported their findings on the Internet, and thereafter discuss the use of the system. The basic question posed is: Can technology, and especially the use of the Internet, be utilised in such away that would allow individuals to work on theirs own yet have discussion, with and support from, their peers, other postgraduate-students, supervisors and experts?

Course conception

The six-week course consisted of three topics related to the use of computers in education. Apart from the students and course co-ordinators, four experts, external to the University and a number of postgraduate students participated in the course. A schedule outlining the topics and source material was provided. Each topic included a theoretical component (writing of an essay), discussion period, a mini project and a face-to-face final discussion. Some core source material was provided for each topic but it was expected that students would find additional information. Essay content was entered into database tables using Web-based forms. The content was added as blocks of information that the writer could reorder. During the discussion period the course co-ordinator, postgraduate students and experts attached comments to the student essays (using Web-based forms) and the discussion forum. Mini-projects were used to put what the students learned during the theory component into practice. In the face-to-face meeting students and course co-ordinators evaluated the learning that had taken place during the two weeks and attempted to integrate the different elements under discussion. The design of the course attempted to implement the five learning activities reported by Saljo (1979) and used constructivist methods where the teacher acted as co-learner with the students constructing their own knowledge both as individuals and as part of a larger group.

Students were evaluated using number of different criteria that include finding of relevant information, quality of their papers, interaction with peers and evaluators, quality of their Mini-projects, and a portfolio of work. The portfolio contained any three pieces of work undertaken in the course, any other information by independent research, additional notes or Web pages that they authored, a personal evaluation of the course and what they had learnt in the course.

Technology

Database technology allied to a Web server was used to create resources required for the course (http://www.nu.ac.za/biology/education). Microsoft ® Active Server Pages (ASP), a server-side scripting environment, can be used to create and run dynamic, interactive Web server applications. With ASP, Web documents are created from HTML pages, script commands, and ActiveX components. This technology is easy to develop, modify and deploy. The dynamic binding of database contents to the creation of ASP pages uses Microsoft ®Internet Information Server and Data Access Components (MDAC) that integrates information from a variety of sources including relational (SQL) and non-relational. MDAC consists of ActiveX ™Data Objects (ADO) and the Remote Data Service (RDS), Microsoft OLE DB Provider for ODBC, Open Database Connectivity (ODBC), and ODBC drivers. The server-side scripting environment uses VBScript or JScript that is executed on the Web server. The ASP technology therefore allows delivery of pure HTML code to the client that contains information stored in database tables on the server and provides an easy method to update server-based databases from content entered into forms on the client Web browser.

The Web site for the course was divided into a number of sections that included an Introduction, Schedule, Discussion Forum, Data Entry, Papers and Participant Information. All sections, except the Data Entry component, were open to all visitors. The Introduction and Schedule section were coded using Microsoft FrontPage while the other parts used ASP linked to a simple Access database (Fig. 1).

The database was used for two activities: entry of data (essays content and comments) and the discussion forum. A record, in the Users table, was created for each user that included the email address and password used to uniquely identify each user. The Group field served to identify the user as either a student, postgraduate, expert or course-co-ordinator. The other fields in this table were used to display information on the Participant Information section.

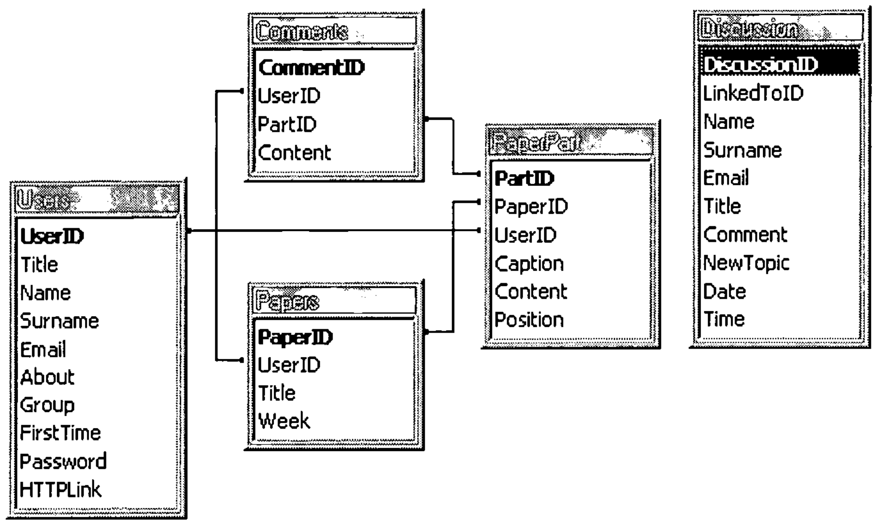

Figure 1. Database showing relationships between tables and unique keys (bold).

In the Data Entry section, users entered the system using their email address and password. User could then edit their personal information or access the papers. The Papers links worked differently depending on the group to which the user belonged. Student could add new papers or edit existing ones. Papers were entered as a number of sections that could be ordered. Other members could view contents of papers and add comments to each section. Records in the Pages table (Fig. 1) represent papers created by student users. Sections of papers were stored as records in the PaperPart table. Therefore, each paper consisted of a Page record and a number of PageParts records. Comments, related to each section of a paper, were stored in the Comments table.

The Discussion section of the Web site used the Discussion table (Fig. 1). Here the screen was divided into two main sections. On the left a list of topics was displayed in a tree format using Java applet (diputree, from dipu at http://www.dipu.com/root.html). Instruction on how to use the system, data entry and display of discussion topics were displayed on the right. A non-Java view of the discussion topics was also available. The Discussion table contained fields that allowed the records to be sorted and grouped according to the discussion thread and only one level was provided for each discussion topic.

In the Papers section both the essays and associated comments were displayed. Therefore the Papers, PaperParts and Comments tables were used to display the HTML pages associated with each paper.

ASP coding

To illustrate the ease of using ASP the code for the non-Java view of the Discussion topics is given in Fig. 2. The symbols '<%' and '%>' denote the start and stop of the script. Two subroutines, AddLinsLinks (Fig. 2, ❶) and AddLine (Fig. 2, ❷), were used. The AddLine routine displays the Discussion topic while the AddLinelinks adds all the records associated with that topic. To create the content for the page a RecordSet object is created on the server (Fig. 2, ❸), database opened using standard SQL and for each unique record the topic link and associated topic threads generated using the two sub-routines. Finally the database is closed (Fig. 2, ❹) and the end page HTML tags added.

```
<% ❶ Sub AddLineLinks( DiscussionID )
  set ra = Server.CreateObject("ADODB.Recordset")
  ra.Open "select * from Discussion;", "DSN=EDUCATION", adOpenKeyset, adLockOptimistic
  ra.Filter = "LinkedToID = " + CStr(DiscussionID)
  if (Err.Number > 0) then
    Err.Clear
  else
    if not (ra.RecordCount = 0) then
      while not ra.EOF
%>             
        <a href="showtopic.asp?id=<%= CStr(ra("DiscussionID"))%>"><%= ra("Title")%>
        (<%=ra("Name")%>)</a><br>
<%      ra.MoveNext
      wend
    end if
  ra.Close
  set ra = nothing
  end if
End Sub

❷ Sub AddLine (DiscussionID, LinkedToID, Name, Title, NewTopic)
if isNull(LinkedToID) then
  LinkedToID = 0
  NewTopic = 1
end if
%> <a href="showtopic.asp?id=<%= CStr(DiscussionID)%>"><%= Title%> (<%=Name%>)</a><br><%
  AddLineLinks( DiscussionID )
End Sub
%>
<html>
<head>
<base target="main">
</head>
<body  link="#FF0000"  vlink="#800000"  alink="#808080"  bgcolor="#FFFFFF"  text="#000000"
topmargin="0" leftmargin="2">
<table border="0" cellpadding="0" cellspacing="0" width="380">
  <tr>
    <td><font size="2" face="VERDANA,ARIAL,HELVETICA">
<%    On ERROR RESUME NEXT
    ❸ set rs = Server.CreateObject("ADODB.Recordset")
      rs.Open "select * from Discussion WHERE (Discussion.LinkedToId = 0);",
      "DSN=EDUCATION", adOpenKeyset, adLockOptimistic
      if (Err.Number > 0) then
        Err.Clear
      else
        if not (rs.RecordCount = 0) then
          while not rs.EOF
            AddLine rs("DiscussionID"), rs("LinkedToID"), rs("Name"), rs("Title"),
            rs("NewTopic")
            rs.MoveNext
          wend
        end if
     ❹ rs.Close
        set rs = nothing
       end if
%>   </Font>
     </td>
   </tr>
</table>
</body>
</html>
```

Figure 2. Example ASP code used to generate non-Java view of Discussion topics.

Results and Discussion

The objective of the study was to investigate the use of modern Internet technologies to build a virtual classroom where students could submit papers for evaluation and discussion by peers and experts. Use of Active Server Pages allied to a simple database was used to create the Web environments where students submitted papers for discussion, peers and experts reviewed the papers and all groups had access to a discussion forum. Each of these three aspects will be discussed separately.

Microsoft's ASP technology and Internet Information Server provided an extremely powerful environment for the development of HTML code that interacts directly with databases. Using VBScript and a simple Access database it was very easy to create the resources required for the course. While the coding of ASP can be tedious at times, it is not difficult to master or implement. All that is required is a fundamental understanding of database structures, basic SQL, VBScript and HTML tags.

Students found it very easy to gain access to the site, and while there were some initial problems with the system, were able to use the form-based interface quickly to submit their papers. The initial problems related to how parts of papers had to be entered into the system, students requiring a clearer explanation from the course co-ordinator and a postgraduate student of how to submit papers. Students suggested that papers could consist of more that one level, which would allow individual sections to be submitted in smaller blocks. While this was a fairly good idea it was rejected as it would require major changes to the database structure and further complicate the system of data entry. While using the core reference material to construct their papers, students also used both on-line and library references. Students appeared to enjoy the structure of the course and found the mini-projects valuable and allowed them to put some of the theory they had learnt into practice. The inclusion of a face-to-face tutorial for each section of the work was valuable. Here students and the course co-ordinator discussed and evaluated what the students had learnt. These discussions also helped the course co-ordinator in identifying problems with the system correcting student's misconceptions.

The use of the system by postgraduate students (peer review) was less than expected. While some postgraduate students made frequent contributions, others did not (the four students made 15, 7, 1 and 0 comments respectively). None of the postgraduate-students experienced any problems in using the system.

Four experts were invited to participate in the course. Of these, two were from South Africa (one at Durban), one from the USA and one from Australia. The input from the experts was disappointing. While two submitted comments, they did not use the system but emailed them to the course co-ordinator. Students appeared to appreciate these comments and reported that they further advanced their understanding. The lack of use by experts of the system is interesting. While there may be many reasons, such as time and commitment, in supporting a course for which there is no direct reward, the evaluation of student papers in a public forum (the Web) is very different from the traditional reviewing process that is normally only between teacher and student. Also, the course co-ordinator found the process of reviewing of papers on the Web very different from grading, or evaluating, a term paper. Such comments could no longer be briefly written in the margins of the paper, but full explanations had to be carefully constructed and formulated. Therefore, comments on paper on the Web required more care and additional time.

The Discussion Forum was not very successful. At first students posed questions via email to the course co-ordinator. During one of the face-to-face meeting a student suggested that the Discussion Forum be used for more philosophical discussion on the Web. While the group agreed that this would be a good idea, a thread started by the one student only contained one additional comments that was made by the co-orrdinator. Student did, however, appear to refer to the topics, for example dates for meetings submitted by the co-ordinator. However, they were not consistent in this activity and consequently all important course information was sent by email to the students. The failure to use the Discussion Forum by the students resulted in a steady stream of email message, from students, postgraduates and experts to the course co-ordinator. Those questions that appeared to be universal were answered using the Forum but many were answered individually resulting in more time being spent using email during the course.

Collectively, these observations highlight a number of important issues. During the past number of years many institutions have created virtual classrooms. Authors such as Winn (1998) and Ryder (1996) argue that such courses will succeed only when supported by appropriate pedagogy. However, the comment made by Ryder that we need to "discover the capabilities and natural constraints" associated with such courses delivered on the Web appears not yet answered. A fundamental question remains: "Does writing of course assignments and assessment on the Web, which is freely available to all visitors to the site, fundamentally change the way in which students approach their papers and the way in which peers and experts evaluate and report on such content?". Students appear to adapt rapidly to the use of new technology and are able to use it successfully to assemble their papers. However, the involvement of peer and expert review appears to be problematic. While both of these groups could make valuable contributions to student learning in a distributed system, neither gains any direct reward. Also, there is a crucial difference in evaluation of papers on the Web: no longer is the process private and confidential, but open. Academic review has for centuries been cloistered in anonymity and the use of the Internet could change this. Such a basic shift in evaluation may be required if we are to use all the power of the Web to teach, but as yet we do not have the experience or wisdom to do this wisely.

In conclusion, the development of a virtual classroom where students, peers, experts and course co-ordinator can interact is easy using Active Server Pages and database technology. Design of a Web-based course on sound educational principles appears to provide students with tools to submit papers and receive comments. However, the use of the Web for open assessment changes the way in which such activities are conducted. For the Web to succeed as a platform for the delivery of course content and the evaluation of student work we need to understand more clearly the move away from anonymity to open truthful and insightful discussion and criticism.

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Providing Reflective Online Support for Preservice Teachers on Professional Practice in Schools

Tony Herrington
School of Education
Edith Cowan University
Perth, Western Australia
a.herrington@cowan.edu.au

Jan Herrington
University Learning Systems
Edith Cowan University
Perth, Western Australia
j.herrington@cowan.edu.au

Ron Oliver
School of Communications and Multimedia
Edith Cowan University
Perth, Western Australia
r.oliver@cowan.edu.au

Abstract:
The forms of support needed by preservice teachers in the practicum setting relate mainly to access to relevant information, resources, guidance and support through communication with university instructors and competent peers. Too often these kinds of support are lacking for students on teaching practice in schools. This paper describes the development of a web-site where students can access a variety of support structures which enable them to reflect on their role and performance as teachers within a resource-rich and fully supported online environment. Through the website, student teachers can access resources such as: lesson plans, samples of teaching methods and activities, links to information sources, on-line and downloadable teaching materials, and discussion facilities to enable students to post problems and queries to peers and lecturers and to receive feedback.

A Reflective Approach to Practicum Support for Preservice Teachers

> I have come, over the years, in spite of all the reform agendas, to believe that the best we can do in teacher preparation programs, through a variety of courses and clinical experiences in intentionally selected schools, is to help academically able and socially committed students enter teaching with constructive dispositions and skills relating to young people, curriculum content, pedagogy, and the power of collective thought; well-developed habits of observation and reflection; reasonable confidence and an understanding that they are entering a process of learning something important every day, working toward the largest possibilities they can imagine. (Perrone, 1997, p. 649)

In today's overstretched curriculum, and with society's increasing demands for the teaching of a growing body of new knowledge, a competency-based approach for learning to teach is obsolete. Students cannot be competent in content and skills that are rapidly changing, or may not, as yet, even exist. As Perrone (1997) argues, it is better to provide students with generic and reflective skills that assist them in their continued learning of any new enterprise. Connecting these generic thinking skills to the context in which they occur is essential. If university programs do not do this they are likely to 'prepare teacher technicians rather than reflective professional educators' (Boyd, Boll, Brawner & Villaumer, 1998, p. 61).

Reflection is one aspect of a complex number of interrelated functions which contribute to task performance (Ridley, 1992), an aspect which is gaining increased attention in recent years after almost disappearing from consideration under the influence of learning models based on behaviorism (von Wright, 1992). Boud, Keogh and Walker (1985) define reflection as: 'those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations' (p. 19). These authors stress that such reflection must not occur solely at the unconscious level: 'It is only when we bring our ideas to our consciousness that we can evaluate them and begin to make choices about what we will or will not do' (p. 19). Kemmis (1985) points out that we do not reflect in a vacuum: 'We pause to reflect ... because the situation we are in requires consideration: how we act in it is a matter of some significance' (p. 141).

Many theorists see reflection as both a *process* and a *product* (Collen, 1996; Kemmis, 1985), and that it is action oriented (Kemmis, 1985). Knights (1985) contends that reflection is not the kind of activity which its name suggests—a solitary, internal activity—but a two-way process with the aware attention of another person: 'Without an appropriate reflector, it cannot occur at all' (p. 85). This view is strongly supported in the literature by others who point out that reflection is a social process (Kemmis, 1985), and that collaboration on tasks enables the reflective process to become apparent (von Wright, 1992).

Another important function of reflection is that it enables the learner to compare his or her performance or understanding to an expert in the field (Candy, Harri-Augstein, & Thomas, 1985; Collins, 1988; Collins, Brown, & Holum, 1991). Collins, Brown and Newman (1989) have also pointed out that it is important for students to be able to compare their performance with others at various levels of expertise. Access to expert performances and the modelling of processes has its origins in the apprenticeship system of learning, where students and craftspeople learned new skills under the guidance of an expert (Collins et al., 1989). Important elements of expert performances are found in modern applications of the apprenticeship model such as internship (Jonassen, Mayes, & McAleese, 1993), and case-based learning (Riesbeck, 1996). Such access enables narratives and stories to be accumulated, and invites the learner to absorb strategies which employ the social periphery (legitimate peripheral participation) (Lave & Wenger, 1991). Expert performances and the modelling of processes, allow students to observe and reflect upon a task before it is attempted. Such reflection, one might argue, is only possible in a learning environment which provides appropriate supports and communication channels to enable reflective learning to occur. And yet the typical experience of preservice teachers on professional practice is one of isolation, divorced from the support structures of their university environment, and without communication channels to their peers.

The purpose of this paper is to outline the development of a web-based resource that provides reflective support and communication to assist preservice teachers learn about teaching in the context of their school practice. Early childhood, primary and secondary education student teachers enrolled in Bachelor of Education and Graduate Diploma of Education courses at Edith Cowan University (ECU) are required to attend between 10 and 18 weeks of school practice during their training. These practices vary from continuous blocks of time in a school to distributed practice where, for example, students attend a half-day a week for one school term. In the context of reducing University and Faculty budgets, coupled with increased pressure on academic staff to increase their research output, there has been a dramatic reduction in university staff involvement in the supervision of students on school practice. This has necessitated developing alternative approaches to assisting students on school practice.

This project set about to provide an improved framework of support for student teachers during their involvement in school practice by providing them with a range of resources to increase content and skill knowledge, and to enable them to reflect on their teaching practice. Initially, the content focus centered on teaching mathematics, however, the generic nature of the skills being developed meant that these abilities could easily be transferred to other areas of the school curriculum. To support and develop generic teaching skills it was felt that students would benefit by having access to rich sources of lesson ideas, particularly those type of lessons that reflected constructivist pedagogy; and guidance and support through communication with content experts and their peers. In addition to their supervising teacher, students would be adequately supported in their practicum settings by having immediate access to:

- Quality curriculum materials to guide lesson planning;
- Examples of exemplary teaching to enable students to compare themselves to 'experts';

- Examples of lesson activities across a range of teaching strategies and content areas;
- Templates with which to build lesson plans and ideas, and teaching materials for use in lessons; and
- Open communications channels to discuss problems and difficulties with their peers and lecturing staff.

Providing support along these lines could be effected through an appropriately designed Internet-based database and information delivery system. The process of using the Internet to communicate between student teachers on school practice and university supervisors has been reported (Casey 1994; Hutchinson & Gardner 1997). Recommendations from these reports include extending the process of communication to students' peers and school supervisors. This project provides such a system with the construction of a WWW site with the following components and attributes:

- A database of prepared lesson materials accessible through a simple search engine;
- Short video clips of teaching approaches and activities to stimulate students' ideas when creating and preparing lesson formats and plans;
- Links to the various information sources useful to students;
- Answers and suggestions regarding known problems faced by students on school practice;
- Online and downloadable teaching materials; and
- Online discussion facilities enabling students to post problems and queries to peers and to staff, and to receive feedback.

All entering students at ECU are provided with an email address and access to the Internet through the university modem pool. The vast majority of students will have access to the WWW in the schools in which they will be doing their practicums. The benefits provided by this resource include:

- Immediate access to required information;
- Ability to collaborate in a virtual community during the practicum and be relieved of the sense of isolation so often experienced;
- Ability to contribute to the database by posting successful materials of their own;
- Ability to share the information passed in the discussion sessions without having to formally participate;
- Problems and queries which surface and are resolved during each practice will be added to the database of known problems and solutions for reference by subsequent students; and
- Problems and queries will provide a significant resource for lecturers and students in their pre-planning for school experience.

Using the Resource

To ensure the successful application of the WWW resource, students are made familiar with its information and organisation before going on school practice. They gain a sense of how best the resource could be used and the real advantages that could be gained through its use. Student use of the resource on school practice can be ensured through prior activities at the University where students are required to explore the resource and all its features and capabilities and to use the resource in simulated practicum conditions by preparing sample lessons. They are encouraged to add materials of their own to relevant sections of the database and to learn appropriate procedures for online discussion and communication through computer mediation. School supervisors are also informed of the resource and encouraged to contribute and use the email facility to communicate with University supervisors. This WWW site is an extensive resource with the features and attributes described above. The site incorporates the following features:

1. ***Interface Design:*** The WWW site interface (see Figure 1) reflects the forms of information contained, and provides an intuitive organisational storage and retrieval structure. Several navigation and data retrieval strategies exist which include hierarchical organisation based on year groups and mathematics topics and a keyword search engine to provide access to the materials.

2. ***Content Development:*** The project has involved the development of lesson activities (see Figure 2 for an example) across a broad range of topics and teaching strategies. There are at least 160 such elements in the database which provides an adequate starting resource for student teachers in schools. The project has involved lecturers in the department of mathematics education creating approximately 40 lesson activities in each of the categories: pre K-2; 3-5; 6-8; 9-12 (and these will grow as the students contribute their own lesson ideas).

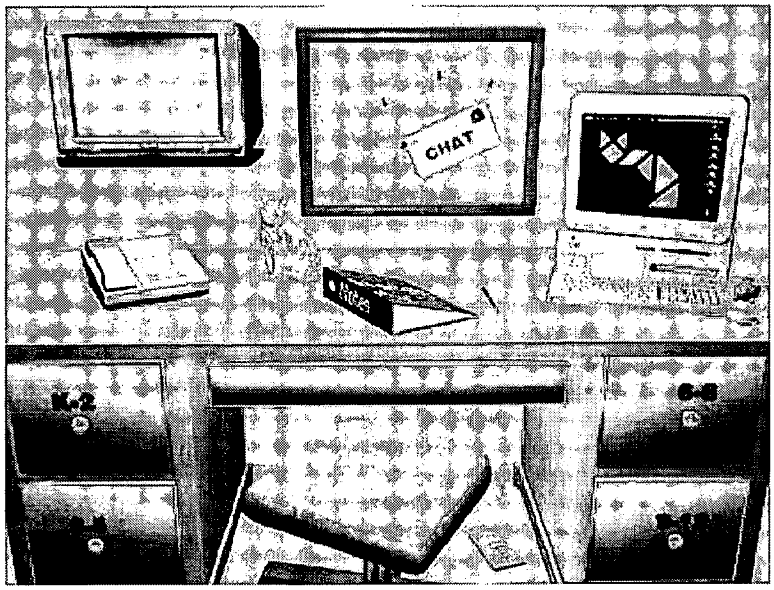

Figure 1: The interface of the web resource

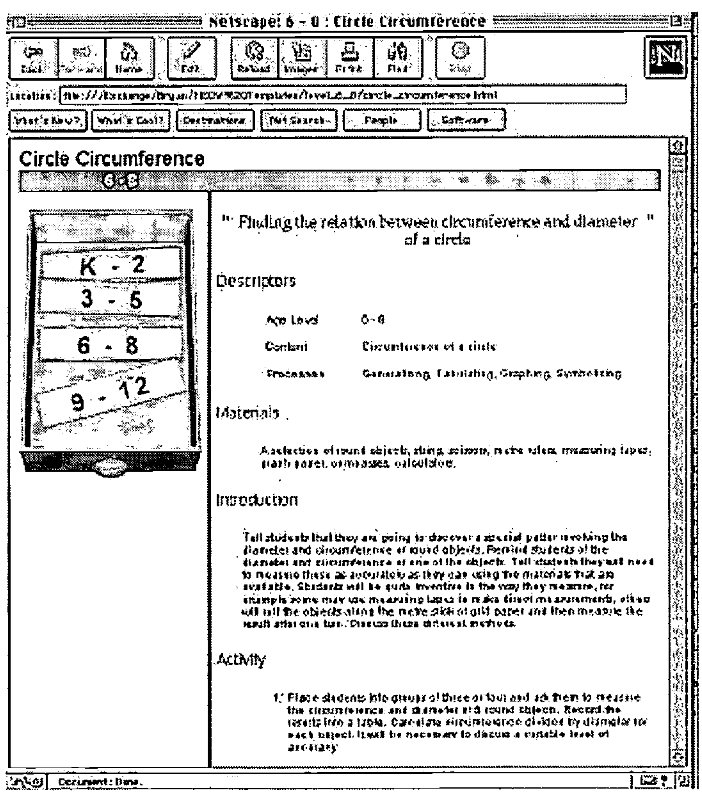

Figure 2: A sample lesson plan

The activities reflect the type of pedagogy encountered in the University methods classes and the directions advocated in such documents as the *National Statement on Mathematics for Australian Schools* (AEC, 1991) and the National Council of Teachers of Mathematics *Curriculum and Evaluation Standards* (NCTM, 1989). Many activities will have accompanying graphics and images, including images from real classrooms where the activities have been trialed.

3. ***Communications Components:*** The development of a customised discussion program for the site supports the forms of communication and discourse described above. The communication capability of the site enables students to cross-post messages and documents providing the full capacity for information and materials exchange. This is an essential component to enable the 'development of a rehetoric for interchanges' (Dede, 1996, p. 168) which is so important for the effectiveness of the students' learning support systems.

Outcomes for Students

Student teachers using this resource gain a diversity of expected learning outcomes developed within the context of mathematics education. These primarily relate to planning for teaching and applying appropriate teaching strategies and generic strategies developed using electronic forms of information, such as:

Generic planning skills:

- Plan mathematics lessons and program a series of lessons
- Select suitable learning experiences
- Select and prepare resources and contexts and plan for all pupils' needs.

Generic teaching strategies:

- Become aware of and apply a range of teaching strategies
- Adapt strategies for individual pupils' needs
- Motivate pupil interest.

Generic information processing strategies:

- Access, create and evaluate online information
- Communicate online.

Evaluation

The project is being evaluated formatively with students throughout the entire period of development in three ways: by student consultation, trial implementation and focus group discussion with student users. With a dynamic and responsive medium such as the WWW, formative evaluation is an ongoing feature, and necessary changes to meet the growing needs of the preservice teachers using the resource can be made at any stage. Summative evaluation of the resource will be conducted, in the first instance, with a qualitative study of a small group of preservice teachers. Students will be observed accessing the resource, then interviewed. The purpose of the investigation will be to assess the impact of the resource on students' selection and preparation of lesson material, the teaching strategies employed by students in their teaching practice, and their use of electronic media to seek information and use communication technologies to establish support networks. Further analytic studies will be conducted based on the findings of the interpretive research.

Conclusion

This paper describes the development of an online resource to be used by preservice teachers while on professional practice in schools. The resource has been designed to support reflective practice by these students as they prepare and teach their practice lessons. The value of reflective practice and its potential to be assisted through the web site comes from several sources. Firstly, the site enables reflective practice by providing a variety of resources from which to gain alternative perspectives on any teaching task. Secondly, communication technologies allow students to establish communication in the language of the culture, and to share stories and anecdotes of their experiences. Thirdly, the site provides exemplary performance and the modelling of processes, enabling students to reflectively compare their own performance to that of experts.

A resource such as this has the potential to transform the professional practice experience from an isolated and anxious one, where students work with minimal resources and supports, to one which is dynamic, collaborative, resource-rich, supportive and reflective.

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Stimulating Reflection on Theory Using a Web-Repository of Student Reviews

Jan van der Veen[1 2], Maarten van Riemsdijk[3], Hans Slabbekoorn[3],
Iris van de Kamp[1]
University of Twente, Enschede, the Netherlands

Abstract: At the University of Twente many courses apply group based learning as a successful strategy for those educational settings in which the application and integration of theory is the main theme. Also the University of Twente encourages instructors to consider the use of information and communication technology solutions if appropriate (Collis, 1996). "People, Technology and Organisation-2" is a course focusing on organisation theory and its relevance for designing business organisations. Students work in project groups studying both theory and case-studies.
To stimulate the reading of theory articles a Web-site was set up. The whole set of 24 articles is too much for each individual student, so each group divides the articles among its members. Every group has to submit for each of the 24 articles sets of 'question & answer' that target the core of the article. The submissions on a particular article together form a resource for all groups, though only accessible for those groups who submitted a serious contribution themselves. In this paper we report on the problem analysis of the educational setting, the web-solution, and on the evaluation results of the experiment which took place in the period September – November 1998.

Educational setting

The University of Twente offers curricula in technical, social and business sciences. In the second year of the School of Management Studies curriculum, 180 students enrol for the course titled " People, Technology and Organisation-2". In this 200 hours course the students work in groups of 6 students each. Two instructors assisted by seven tutors (senior students) take care of lecturing and group support.

The learning goals of the course are (Smit & van Riemsdijk, 1998):

- Knowledge and insight in the field of organisation theory and design.
- Being able to apply this knowledge and insight in problem solving strategies.

The course uses the textbook of Daft (1998) and a set of articles from the research field. In parallel the students work on the evaluation of case-studies. In the course four phases can be discerned, together spanning a period of 10 weeks:

In the first phase, the main topic is an introduction into several schools of thought in the domain of human resource management. Starting with a re-examination of Taylorism, students are introduced to the work of Lewin, Mc Gregor, Trist & Bamforth. Parallel, students are asked to study the Uddevalla Volvo plant and the Nummi (Toyota/GM) plant with respect to human resource aspects of the production organisation. They are invited to reflect on these two plants using the literature. Finally, they are asked to suggest (first/preliminary) redesign options for Morgan Cars on this topic, after analysing Morgan Car Job design.

The second phase deals with contingency theory and organisation design. Technology and Organisational environment are the main topics. Using studies by Perrow, Thompson, Lawrence & Lorsch, Woodward etc. students are again stimulated to analyse the Nummi and Udevalla plant in this respect. The second half of this part is again devoted to analysing and "redesigning" Morgan Cars.

The third phase deals in a similar way with 'Power, Politics and Decision making', focussing mainly on a stakeholder approach and of course on decision theory. Again, Nummi and Uddevalla serve as a practical illustration and practice material, Morgan Cars as a serious effort for re-design. Finally in the fourth phase

[1] Educational Centre
[2] Centre for Telematics and Information Technology
[3] School of Management Studies
Information via: j.t.vanderveen@oc.utwente.nl

of the project, students are invited to attempt a full re-design of the Morgan factory on all topics touched so far and on all other aspects of the organisation that they think are relevant to the task.

Problem analysis

The first three phases of the course start with the study of about eight rather basic and theoretical articles. The concepts and ideas from these articles then have to be translated into practical ideas for changing a case-situation. In order to be able to do so, it is essential that all the articles have been studied rather thoroughly. Ideally, students will interchange insights and concepts encountered in the literature. Students are more likely to raise their problem solving capabilities when working together with fellow students with comparable but slightly better capabilities (Vygotsky, 1978). They are working in each other's "zone of proximal development". This means that in some way or other, a situation has to be created in which students that have read the same material can share their findings. Previously this was attempted by prescribing that at least two students in every group should read the same articles (Smit & van Riemsdijk, 1998). These students could then discuss the articles amongst themselves, and present their findings to the rest of their group. It turned out however, that students read not two but only one article each, blowing this strategy of communication about theories and concepts right out of the water. Instructors, as a consequence, found that in workgroup sessions, individual knowledge of separate articles was adequate, but that theoretical knowledge had not spread throughout groups but stayed firmly located with one 'expert-student' per article per group. This resulted in a lack of overview within the groups and in sub-standard knowledge and grasp of the different theories and concepts involved by all members of the groups. An additional problem would arise if individual students would not have understood the material sufficiently. Lacking any possibility of communication with other students within their group on a specific article (no one else would have read the same material) their problem could not be solved and would spread throughout their whole group. Given these results, obviously, something had to be done.

Solution design

It was concluded that the decisions on who was to read which article should be left to the responsibility of the groups themselves. To alleviate the problems mentioned before however a web-site was designed. The web-site was designed to solve several of the problems encountered. First, to stimulate the reading of the articles each group was obliged to submit a contribution through the Web-site (figure 1). This contribution should consist of two relevant questions and their correct answers about each article that was read. The submitted Q&A would be screened (figure 2) by tutors helping the instructors. They would accept or reject (with some comments) the contributions. This gives the students full flexibility with respect to the planning and execution of their tasks, while at the same time making sure that everybody does what is expected of them.

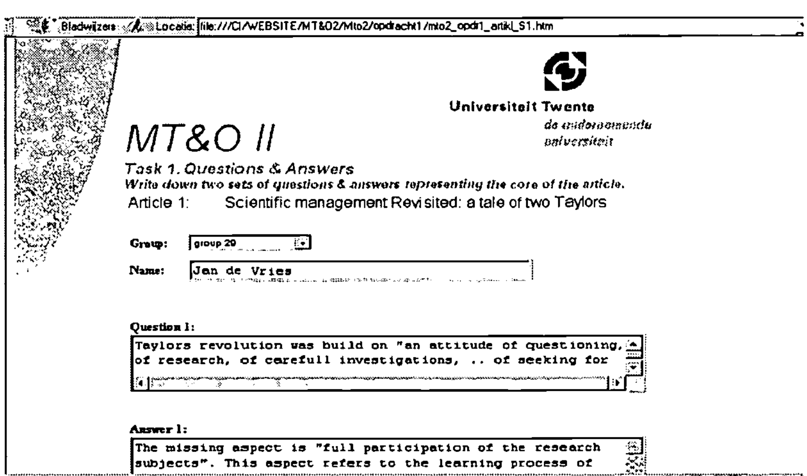

Figure 1. Web form for submitting 'questions & answers'.

Second, once acceptable questions and answers are submitted, the student gets access to another part of the site, allowing him/her to monitor all the other positively assessed contributions about his/her particular article, submitted by students from other groups. In this way also a treshold was built in to prevent 'free rider effects' when students copy from other contributions (Ronteltap & Eurelings, 1997). In the last step students rate the group submissions, indicating which five contributions they like best. The solution is described in figure 3.

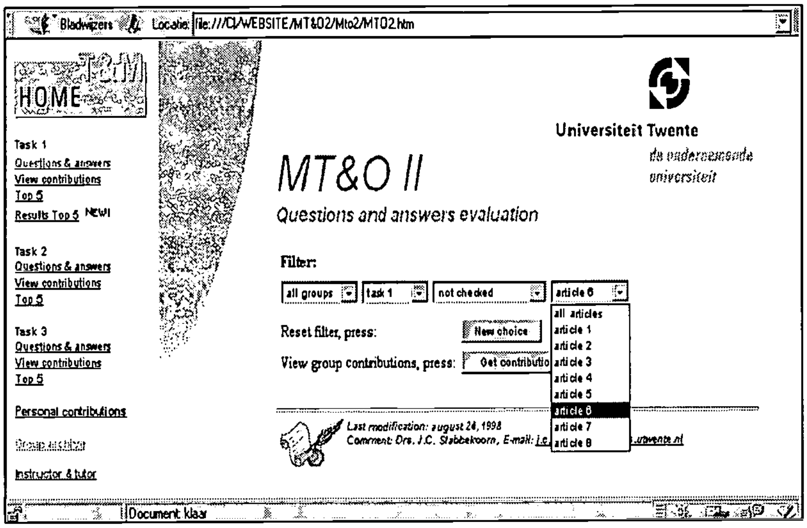

Figure 2: Tutor evaluation module, also showing the course menu on the leftside of the screen.

So, while accepting the fact that students would typically read only one article, we tried to provide for a workspace where some form of communication with other 'experts' would be facilitated. Students would be 'rewarded' for their effort a) by being allowed to enter the site and b) by being able to read other correct questions and answers about 'their' article. Using this broader knowledge, they would be more secure about the work they had done and be able to contribute more to discussions during their group meetings. At the same time, this had the advantage that we could be reasonably sure about the level of knowledge and understanding that students would have about the different articles. This, of course, was theory.

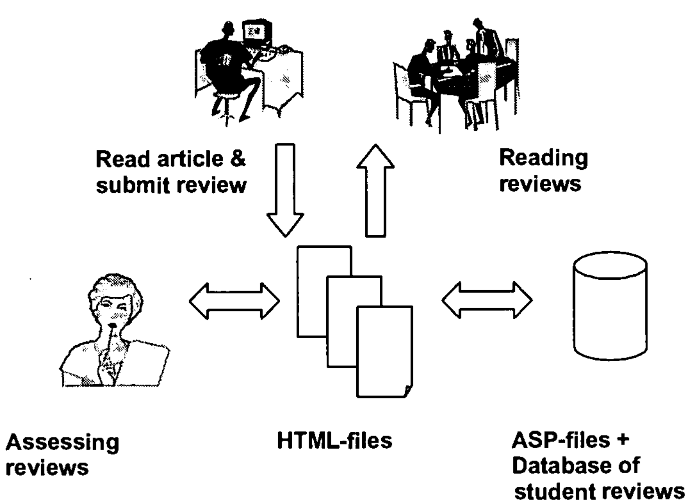

Figure 3. Main activities with respect to the Web-Repository of student reviews.

Technical set-up

Active Server Page (ASP) technology was used to implement writing to and querying from the Access database that contained all group contributions. To limit the access to the resources to only those groups that had made a proper contribution, the membership mechanism of BSCW (Basic Support for Collaborative Work) was used. After each assessment those groups entitled to access, were granted membership to those workspace folders containing the HTML-file making a call to the database (BSCW, 1998). The groups could also use BSCW workspaces as a group archive if they wished so.

Evaluation questions and methods

The main goal of the implementation and therefor the main question involves the value of the website in improving discipline of reading and improving insight of students in the theory described by the articles (Q1,Q3). We were interested to see how the web-site would support the work of the students (Q2, Q4), the tutors when assessing the quality of the questions and answers, and of the instructors when having a look of the progress of the students, and taking an overview with respect to the quality of the students contributions.

With respect to the technical side we wanted to built and implement the interactive website as described. And, as no special training was given we were interested in the ease of use, and were curious to know if the web-site would function well (Q5). To find answers, data are gathered in different ways with involvement of student, instructors and tutors. Our research questions and evaluation methods are summarised in table 1.

Evaluation methods **Questions**	Student questionnaire	Student interview	Tutor interview	Instructor Interview	Log analysis
Q1 How good is overall student insight in theory ?	*	*		*	
Q2 Did the intended use of the Web-site take place ?	*	*	*	*	*
Q3 Did student insights improve as a result of this ?				*	
Q4 Is the Web-repository perceived as helpful ?	*	*		*	
Q5 Did the Web-site technically function well ?	*	*	*	*	

Table 1. Research questions and evaluation methods.

Results and conclusions

With only limited efforts (80 hours) a Web-repository of student reviews and group archives was set up using a database driven Web-site (Q5). From the database and logged data we found information on the use of the web-repository, table 2. The submission of questions and answers was done by the groups as planned (Q2). Most groups (23 out of 28) submitted contributions for 20 or more articles (out of 24). The students reported that they used more than 30 minutes to read an article. They found it difficult to formulate a good question and answer, indicating that there was additional reflective effort needed after having read the article (Salomon, 1984). The instructors reported that students attending the lectures in general were better prepared compared with the previous situation (Q3, Q4).

	1st phase	**2nd phase**	**3rd phase**	**Overall**
Number of submissions	246	218	195	659
Positive assessed submissions	81%	58%	61%	68%
Reading other group submissions	79%	39%	26%	48%
Top 5 contributions	44%	16%	n.a.	n.a.

Table 2. Some statistics on the use of the Web-site of the course. Mistaken entries (66) in the database (empty forms, duplicates) are removed from statistics.

Overall 68% of the contributions was assessed positively. The drop in the percentage of positive assessed contributions in the second phase was caused by comments of one of the instructors urging the tutors to be a bit more strict in their assessment. During the same meeting, after the first phase, the tutors indicated that it is sometimes difficult to make a "ok" / "not ok" choice as sometimes a contribution contains both good and bad parts.

The percentages of students reading other group submissions one has to take into consideration that access was only granted to those that had submitted a good submission themselves. Therefor this 'reading peer contributions' percentage can never be higher than the 'positive assessed contributions' percentage. The top 5 competition was not used very much. Reading other groups submission does not have a high added value as perceived by the students. At the time of the submissions all learners are still in the orientation phase and most have not yet reached expert level (Q1). Also time pressure to move on to other deliverables is a reason for lack of interest in this feature. Because of this lack of interest the instructors decided to drop this feature in the third phase (Q2).

Via a questionnaire students (N=83, response=50%) were asked to indicate which workform had contributed to acquiring knowledge, improved insight and to learning better to apply knowledge. Compared with group discussions, tests and working lectures that were applied in the same course, the website repository received the lowest score, table 3 (Q4). It may be that the hoped for 'peer-to-peer' learning effects [Vygotsky, 1978] across groups, are too weak when the peer contribution is 'tunneled' through technology with no opportunity for discussion. Students report that they used the group discussions to share their individual findings on the articles within the group. It may be that working with the Web repository is a good preparation for this discussion, more than for exchange of opinions across groups.

	Tests on theory	Group discussion	Working lectures	Web repository
Acquiring knowledge	2.2	2.8	2.2	4.3
Improving insight	3.2	2.5	1.4	4.2
Applying knowledge	4.1	2.2	2.3	4.1

Table 3. Average student appreciation of work forms applied in the course (1=most important, 5=least important).

The web-site user interface was appreciated as easy to use (Q5), table 4, even though we feel that improvements are possible. Browsing through other group contributions for instance now takes four mouseclicks per item. This will be reduced to one mouseclick per item.

Question	Score
It was difficult to formulate a good question and answer set.	2.8
If I wanted to enter data in the Web-site, it was easy to do.	1.9
I had a good overview of what I still had to do.	2.5
It was fun to work with the Web-site.	3.7

Table 4. Student appreciation of the Web-site (1=agree very much, 5=disagree very much).

The flexibility to submit from any Internet connected pc was used not only by students, but also by the tutors when assessing the contributions. From the responding students 81% indicated that they had used their home pc for some of the submissions. Analysing submission time stamps shows that 47 % of all submissions arrived close before the deadlines on Mondays. For 90 % of the submissions the time stamp is between 10.00 and 17.00 hours. For this students mainly used their project room pc or other personal computers at the Department, possibly because from their home pc connectivity costs are a treshold.

The access mechanism for the overview of all contributions involves the tutors granting access. This human step turns out to be error prone. The failure rate of 6% dropped after the first phase towards occasional mistakes. Still the automation of this step will make the design as a whole more robust, at the same time preventing the good students from becoming frustrated when they find that access is not granted by mistake.

Discussion

It turns out that the discipline of reading theory articles has been enhanced. As a result of the need to formulate 'question and answer' combinations, student reflection was also stimulated. Of all submissions, 68% was of acceptable quality. But what is acceptable ? We wanted people to get to the core of things, but most students did not reach that level. It is now seriously considered that the students will have an optional course in their third year in which those interested in the course topic, can further improve their level.

The hoped for cross-group exchange of expertise on each article, was not adopted by most students. The reasons have to do with the effort needed to read reviews from more than 20 groups, which would take more time than reading the article itself. So most students no more than scanned the contributions of other groups, resulting in almost random top five scores. Also the mentioned quality aspect of the submissions, did not stimulate students to keep reading.

As our students report that they rely mostly on the exchange of expertise within their own peer-group, we plan to redesign the web-repository in such a way that it supports these group members first of all. We will ask the students to submit short summaries on the articles. Apart from basic quality assessment of the submissions, the tutors and instructors will make a shortlist of excellent submissions, adding some expert remarks per article as a conclusion. This way we hope the Web-repository will support each group by building a portfolio of article summaries per group, and by offering an efficient shortlist per article for the experts that have read the same article.

Acknowledgements

Many people contributed to the making and execution of this project, in particular we mention Eelco Laagland and Henri Holtkamp.

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"Web-Constructivism Using Javascript"

Anthony 'Skip' Basiel, Dr. Matthew Jones and Dr. Kay Dudman
School of Computing Science
Middlesex University
London, England
a.basiel@mdx.ac.uk, m.jones@mdx.ac.uk, k.dudman@mdx.ac.uk

Abstract

This paper illustrates how the Constructivist Learning Theory can be demonstrated through the use of Javascript in a web-based learning environment. The power of stand-alone multimedia applications can now be replicated on the web through many types of plug-ins. However, they are tedious and time consuming to download. Client-side Javascript is the answer this research proposes as a fast, reliable alternative. By embedding Javascript throughout a web-based tutorial system the principles of Constructivism guide the Learning Environment Designer (LED) in the development of a web-based tutorial system.

Web-Constructivism

Constructivism is the current dominant learning theory [Bruner 1966, Hein 1995]. The Internet is a well suited distance learning media to support this methodology . This paper shows how using Javascript the following sub-set of Constructivist principles [Boyle 1997] can be adapted to a web-based learning environment:

1. Support the active construction of knowledge in the mind of the student.
2. Embed learning in a social experience.
3. Use multiple modes of representation (multimedia).
4. Support the sense of ownership and a voice in the learning process.
5. Give the opportunity for reflection. (Ideas must be revisited for learning to occur.)
6. Support interactivity with feedback, thus promoting motivation.

A more detailed explanation of Constructivism can be found at: http://skip.mdx.ac.uk/Report/Chapter2.htm

Two types of interactivity and feedback are offered to the student in this web-based tutorial system; 1) student and system 2) student and participants. The first is interaction between the student and the system. This can result in a navigational movement through the environment by clicking buttons / links .Feedback prompts (message boxes) can alert the student about their progress through the content of the tutorial. The second form of interactivity is between the participants in the learning system. One example of this is collaboration between peers, while the other is communication between the student and tutor / subject expert.

Javascript Tools to Illustrate Web-Constructivism

Although there are many multimedia options on the Web, most require specialist software which can be a slow, time consuming process of down-loading plug-in applications. The Minimalist approach suggests using the simplest method to attain the desired goal [Boyle, 1997]. Using a client-side scripting language, like Javascript, supports this approach in web-based learning environment design. The basic specification for viewing these examples is a Java capable browser that is set to view graphics / animated .gifs. An alternative method of distribution would be to place the files on a CD with a copy of a browser that would allow the information to be accessed locally.

This research supports a problem-solving seminar teaching strategy which encourages an active use of the students prior knowledge to argue with his peers to produce a resolution. There are several steps to this protocol [Jackson 1996, Bensusan 1995]:

1. A starting problem is introduced with its related real-world context.

2. Drawing upon prior knowledge and on-line research sources (i.e.- digital libraries, museums, universities, etc.) help form a preliminary conclusion.
3. Collaborate and confront peers to reaffirm or reassess that solution.
4. Compare this answer to a sample solution produced by the tutorial subject expert.
5. Reaffirm or reassess the answer based on that information

The main categories of functionality for using Javascript in a web-based learning system are discussed chronologically as they would appear throughout the lesson:

1. passwords
2. personal name entry
3. multimedia content
4. new browser windows
5. alert boxes
6. self assessment
7. e-mail tools
8. graphically representing feedback

1. passwords

Security is an issue for any on-line learning system. There are three levels of password protection [1] available with Javascript. An Alert Box prompts the student for passwords to enter the lesson. The collaborative nature of the web supports the second Constructivist principle (embed learning in a social experience) allowing participants on-line social exchange via e-mail, news groups, computer mediated conferencing (CMC), Internet Relay Chat (IRC) rooms and video conferencing [Laurillard 1996 & Brunner 1997].

2. personal name entry

To personalise the lesson introduction of the start problem Javascript can be used to prompt the student for their name [2] which is then placed at the top of the page for each use. This reinforces ownership in the learning process.(figure 1.1)

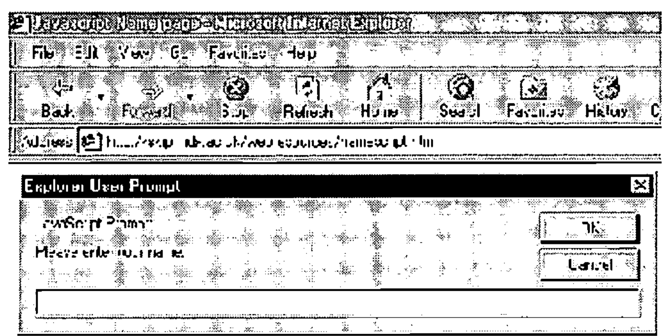

Figure 1.1 Javascript prompt for username

3. multimedia content

A number of Javascripts are available to present the start problem and related content which make use of multimedia to support multiple modes of representation. User interactivity with the material encourages motivation from the participant which supports the sixth Web-Constructivist principle listed above. Information can be in the form of text, still images, animated .gifs (slide show), .avi movie files converted to animated .gifs (using GIF Constructor Set software - http://www.mindworkshop.com/), a series of .gif images taken to simulate a circular pan effect [16] and/or sound as .wav and midi files.The graphics can be image maps which have clickable hyperlinks to increase interactivity. Other multimedia tools requiring special plug-ins are not recommended by this study (i.e. - Quicktime movies for a 360 degree virtual reality effect).

4. new browser windows

There is a Javascript [3] which allows a new browser window to appear over the original screen. This can vary in size, location and features. It can be used to reinforce the content by representing it in another modality. This 'top' window can contain animation to imitate a media player. Sound can be embedded in the HTML file to play upon the page opening or on a mouse click or mouse over event handler.[15] The new browser window can act as a 'windows-help-file' by placing hypertext to offer glossary terms or how-to instructions. (figure 1.2)

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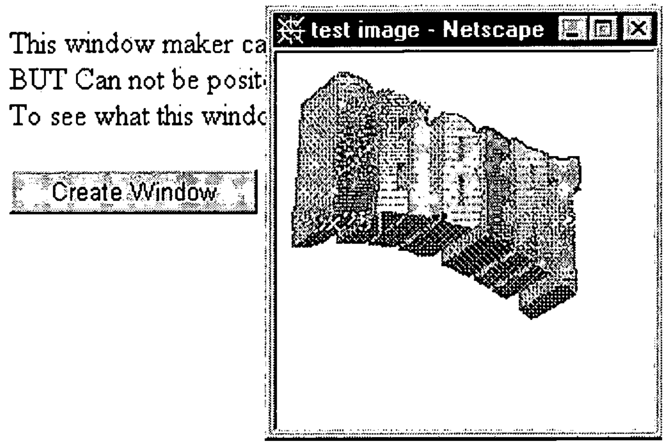


Figure 1.2 Javascript new browser window

The Annotation window is a variation on this theme allowing the student to bring up a on-line note pad of sorts. With the new browser window set to include the title bar menu the student has the option to open the window in the HTML editor of Netscape. This allows them to add text, images or links to an HTML document which can then be stored locally or FTP'ed to a public site [17]. This allows the student to keep an on-line logbook or journal. This can be used for assessed work or as an evaluation methodology [Mason 1996].

5. alert boxes

There are three main types of alert boxes; a) message b) feedback c) exit.

a) message

Alert Boxes (a.k.a.: message boxes, prompt boxes, etc.) are another Javascript tool to promote an active, immediate response from the student in the learning process. There are a variety of ways they may be placed throughout the delivery of the tutorial content. For example, upon entering the HTML page containing the sample solution an Alert message form [4] can prompt the student to confirm that they have developed their own solution *before* reading the tutor's example. This Javascript tools again illustrates the principle of increasing learning through interactivity.

b) feedback

At anytime during the delivery of the content an immediate feedback response is available by clicking a button which may produce an Alert Box response [5] or some text on the page [6]. The text can be a positive/negative prompt (i.e.- "Correct! Well Done. or Sorry! Try Again.") or directions to the location of supportive material (i.e. - "Correct: More details can be found at this URL: http://www.morestuff.com/ or Sorry! You may wish to review this material before going on: http://www.reviewstuff.com/")[7] . (figure 1.3)

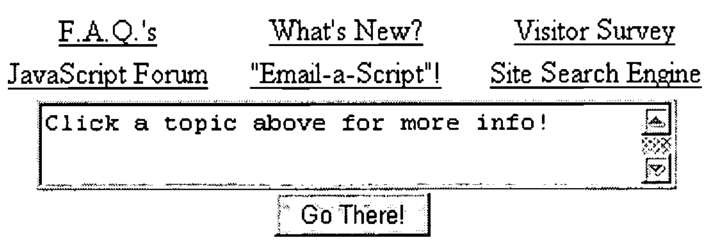


Figure 1.3
Javascript formative evaluation (feedback)

c) exit

Upon completing a section of the tutorial an exit prompt can be issued. Clicking a next or exit link will bring up a "Do you wish to leave this part of the lesson?" query [8]. These embedded Javascripts prompt the student to reflect upon their learning experience throughout the tutorial which supports the fifth principle (give the opportunity for reflection).

6. student self assessment

Student self assessment is a powerful method of encouraging reflection, a necessary part of the learning process [Laurillard 1994]. This research suggests using self assessment as a *formative* method of evaluation (feedback) in the learning system in addition to the traditional summative (end exam) assessment techniques.

There are three general categories of self assessment; a) closed response b) open response c) mixed.

a) closed response

Two closed methods are multiple choice questions [9] and matching [10] using Javascript. Both give immediate feedback, thus supporting interactivity between the student and the system illustrating the sixth principle.

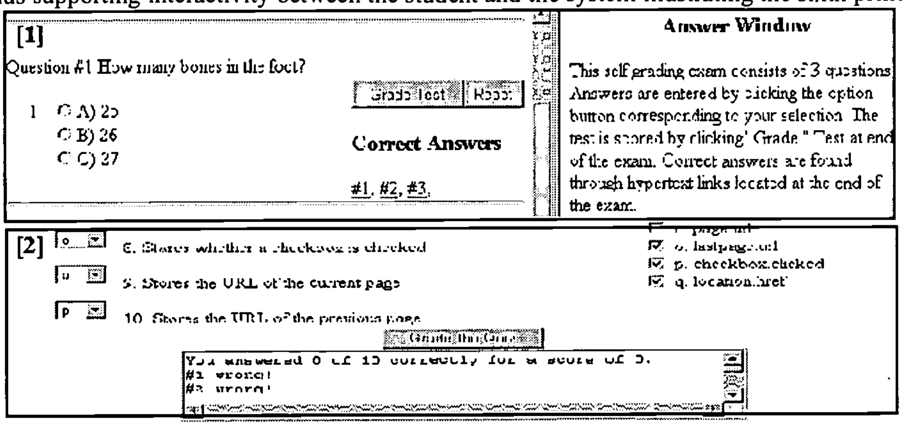


Figure 1.4 Javascript self assessment

b) open response

There are three methods for exploiting the e-mail Javascript tool; 1) preformatted distribution lists 2) use preformatted subject headings to filter responses 3) preformatted e-mail surveys

1) preformatted distribution lists

A Javascript e-mail distribution list illustrates an open response method. [11] By clicking a button a preformatted e-mail message box with an open-ended question can be automatically sent to the group for collaboration and discussion. The student's social experience (principle #2) is supported by this tool. The tutor may also receive a copy of the submission. The student will not be able to use the e-mail reply button since the message was posted to their own address. It is necessary to include the original URL for the distribution list link in the body of the message. The student has the flexibility to return there and reply to the comments .

2) use preformatted subject headings to filter responses

Many e-mail applications have filtering capability which would allow the e-mail generated with a preformatted subject heading to be placed into a specific folder [Brunner 1997]. This has the benefit of helping the on-line tutor organise the potentially large number of correspondence. Alternatively, the e-mail address used for the CC: prompt can be a separate account designated for that on-line class. Many free e-mail services are now available on the web which can be used to receive specific student responses (i.e. - http://hotmail.com/).

3) preformatted e-mail surveys

Reflection can be encouraged after the lesson is completed. On-line surveys can be submitted as HTML forms [12] or as preformatted e-mail questionnaires [13], both of which get mailed directly to the tutor for interpretation and action. This strengthens the learning process by supporting the fifth Web-Constructivist principle. (figure 1.5)

The text submitted from the HTML form will appear as one continuous line of characters in the body of the e-mail message. It is necessary to use software (such as *mailto:Formatter v. 4.01 - rpfries@interaccess.com)* to format the text into separate lines.

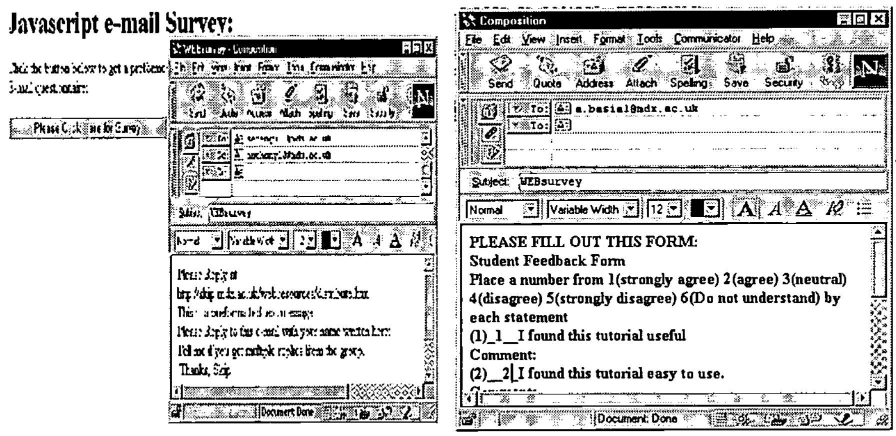


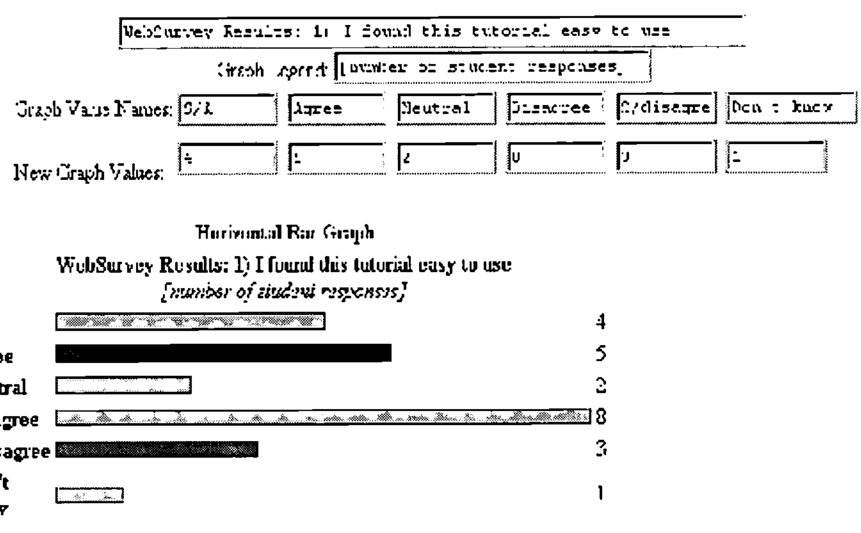
figure 1.5 e-mail surveys

c) mixed

A mixed response combines a fixed reply and open-ended option. This form of feedback is the strongest methodology for gaining both statistical data and the 'unexpected' comment. An example of this is a Likert scale survey which includes an optional description (i.e. - I found the tutorial 1) good 2) fair 3) bad Why ___)(Mason 1992).

8) graphically representing feedback

The data collected by the web-survey can be inserted into a Javascript chart builder to provide a graphical representation of the student feedback for the tutor. [14] This can be printed with the current date on the page for record keeping purposes. This script supports the principle of using multiple forms of representation. (figure 1.6)



Summary

Javascript can support Web-Constructivist principles through every stage of the problem-solving seminar teaching strategy. The learner makes active use of the knowledge by interacting with the tutorial system, on-line resources and colleagues in the lesson. This social approach to learning can be achieved using Javascript e-mail tools. Information can be presented in a number of multimedia formats using images, animation, sounds and simulated virtual reality. An alert box which places the student's name on the HTML page empowers a sense of

ownership. Using formative feedback tools embedded throughout the tutorial the participant has the opportunity to voice their opinion, thus prompting change in the tutorial content or delivery methodology.
Reflection, an important principle in the learning process, is built into the teaching strategy protocol. At the start of the lesson the student is prompted to reflect in order to solve the starting problem. At the end of the lesson self assessment tools also allow review and support reflection. Web surveys prompt the student to reflect on the learning experience and provide the Learning Environment Designer (LED) with the formative feedback necessary to alter the tutorial system to meet the student's needs. Throughout the tutorial the student is prompted to interact with the system, participants and tutor / LED to promote motivation through feedback.
This research demonstrates that by using a problem-solving seminar teaching approach supported by Javascript tools and using the protocols developed in this study a true Web-Constructivist Learning Environment can be realised. An example of this can be seen in the research case study: DELBERT (Digital Environment Learning-Based Evaluation Response Theory) Tutorial System. The URL for this research project is: http://skip.mdx.ac.uk/

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The Development of Online Integrated Japanese Education System "Terakoya"

Shinichi FUJITA, ChunChen LIN, Kazuto YAMADA, Seinosuke NARITA
Department of Electrical, Electronics and Computer Engineering,
School of Science and Engineering Waseda University, Japan
Narita lab, Sci. & Eng., Waseda University 3-4-1 Shinjuku-ku Okubo, Tokyo, 169, Japan
fujita@narita.elec.waseda.ac.jp

Abstract: The times when computers were literally used only for computation have ended. Multimedia (the synthesis of text, pictures, sounds, etc.) has became a widely used term, as information technology progressed. This is not an exception in the field of education, where much research is being conducted, to make use of multimedia in Computer Assisted Learning (CAL) systems. This paper describes a Japanese education system using multimedia towards the non-Japanese.

1. Introduction

In recent years, the number of foreigners trying to learn Japanese has increased. However, it is difficult to master Japanese even after having lived several years in Japan. The singularities of Japanese, which we will show, remain the first reason.

- The Japanese language, besides hiragana and katakana syllables, uses Chinese characters (kanji). Hiragana and katakana are phonograms, while kanji are ideograms. Languages using combinations of phonograms and ideograms at the same time, in this way, are very uncommon in the world.
- On one hand, the alphabet used in America and Europe has about 50 letters, including capitals. On the other hand, there are over 3,000 kanji characters. In Japan, pupils are expected to learn over 1000 kanji during their 6 years of elementary school. Therefore, the speakers of native English as well as Indo-European languages are troubled by the complexity of kanji: their language does not require intense writing practice nor need to discriminate between numerous characters.
- Some kanji characters are very complex. Their shape is sometimes difficult to differentiate. (Fig.1)
- Many Kanji characters have several pronunciations, while others share the same pronunciation.
- Some words change their meaning depending on the position of the accent. For example "hashi" in Japanese means "chopsticks " when the first syllable is accentuated. It means "bridge" when the accent comes on the last syllable.
- Calligraphy (shodo), an important part of the Japanese culture, pays much attention to the stroke order and the shapes of the characters strokes: "hold", "sweep", "curve ", "stop" etc. (Fig.2) These concepts are essential to the foreigner who wants to master Japanese. They cannot be mastered without practice.

嫁暇禍靴寡歌箇稼課蚊我
戒改怪拐悔海界皆械絵開
街慨該概垣各角拡革格核
学岳楽額掛潟括活喝渇割
缶完肝官冠巻看陥乾勘患
勧寛幹感漢慣管関歓監緩
岸岩眼頑顔願企危机気岐
起飢鬼帰基寄規喜幾揮期
偽欺義疑儀戯擬犠議菊吉

Figure 1: Well-used Kanji characters in Japan.

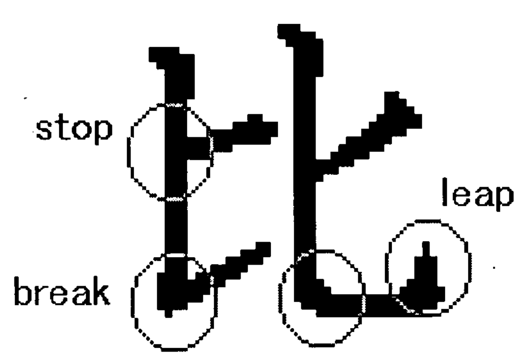

Figure 2: Stop,curve,break and leap

Thus, it is difficult for foreigners to master Japanese. However, the use of multimedia is effective in Japanese education. A sample animation movie can show the stroke order and speed, while the pronunciation and the accent of the word are heard. Of course we cannot ignore the effect of the interest. Using a computer is fun, especially for the children who like computer games. Besides, finding a kanji is faster when using a multimedia database.
Previously, we had developed "Terakoya on the Web" (Omae 97) and "Terakoya Kanta" (Fujita98). This time, we present "Terakoya", an Integrated Japanese Education System, which include them.

2.Past works

There are some software products for Japanese education. They can be classified into "dictionary" and "drill" types. They have the following features and problems.

2.1 Dictionary type

These are electronic dictionaries, giving information on characters. They allow quick reference to pronunciation, sample usage, number of the stroke, etc. But they cannot be used for self-teaching by themselves. They must be used with other materials, such as textbooks and/or drill books.

2.2 Drill type

These can be used for study with input devices, mouse or keyboard. There are three important skills to master a language.

1. Reading
2. Writing
3. Talking and listening

Many CAL software products for Japanese can teach only one of these skills, which is not enough complete to learn comprehensive language skills. Besides it, they tend to provide only little information on characters or words, and do not have much effect on their own.

When these two types of software are used in classroom situations, there is sometimes a big difference between what CAI provides and what the teacher wants to teach. The teacher may think "There is no Kanji characters in this software that I would like to teach" or "I don't like to teach this usage now" or "I want to use this sentence as example".
Our system has some functions to solve these problems as following.

- We developed four types of drill software. One to learn reading skills, another, writing skills and at last, talking skills. Each software is integrated closely. This system can achieve an integrated learning. Students can train reading skills, writing skills and talking skills for a chosen kanji.
- We have integrated database and drill software. This approach can compensate the lack of information in drill type software and the lack of teaching function in a database type software.
- Our system can be configured to fill up a gap between the teacher's needs and the producing of CAL. This is a good help to use CAL effectively in classrooms.

3. For effective CAL

Developing effective CAL requires careful consideration. Animation or sound effects, which would make some children happy, could be only disturbing for adults. For the learner, who wants to travel to Japan without difficulty, it may be unpleasant to be advised on some details, like the stroke order of characters. We must think over the situation in which the system will be used. Is it intended for self-teaching or will it be used in classroom? We have developed software with an eye on the following points.

Generation's gap
- Children: Joyful animations and sounds, easy comments.
- University Students: efficient use.
- Adults: Restful, easy handling.

Situation's gap
- For self-teaching
- In classroom with one computer.
- In classroom with many computers

The goal gap
- So as not to be in trouble during the trip to Japan.
- So as not to be in trouble living in Japan.
- For a native Japanese

We have prepared some learning modes and optional functions, like animation. Our software can compensate the difference of the learner's age or goal. Most software we know is developed for self-teaching or without a general idea of the target. Our software can be also used in classrooms.

4.Model case

In this section, we show an example of effective usage of our system.

Situation: In the Japanese class. There is a computer in the room and all students can see the monitor through the projector.

1. In the class, the teacher selects the character he wants to teach in the textbook or another paper document and searches it in the "Kanta" dictionary software.
2. All students study the information of the character on the projector: the pronunciation, the usage etc,
3. One or two of the students practice the character with the "Kanta" drill software. Other students can look at the appearance on the projector.
4. "Let's practice!" All students practice the character on the paper drill made by the making drill module of Kanta
5. At home, the students can review the lessons on the Internet with a PC.

Of course, besides this usage, our system can be used for self-teaching in classrooms with a computer for each person.
Until now, we could not find CAI software supporting the whole features, from the classroom to self-teaching. Our system does it.

5. Japanese integrated CAI system "Terakoya"

On this base, the integrated CAI system "Terakoya" is composed of three modules.

5.1 Database module

This module has all the information, which a paper dictionary has. Besides, it uses multimedia for the animation of the strokes and the pronunciation of the characters. Our multimedia database has the following good points compared with a paper dictionary.

- Our multimedia database uses animation sequences to teach the stroke order and rhythm. It is about "leap",
- In Japanese, the meaning of some words can changes depending on the intonation. For example, the word "hashi" means "chopsticks" if the accent is put on the first syllable. It means "bridge" in case when the musical accent is put on the last syllable. It is difficult to express these differences with a paper dictionary. We can do it easily with the sound of our multimedia database.

● The desired information can be found faster than with a paper dictionary.

This module is closely co-ordinated with drill module and the student can practice the character he encounters. Besides, the teacher can make paper drills by choosing the necessary data in our database module with the "making

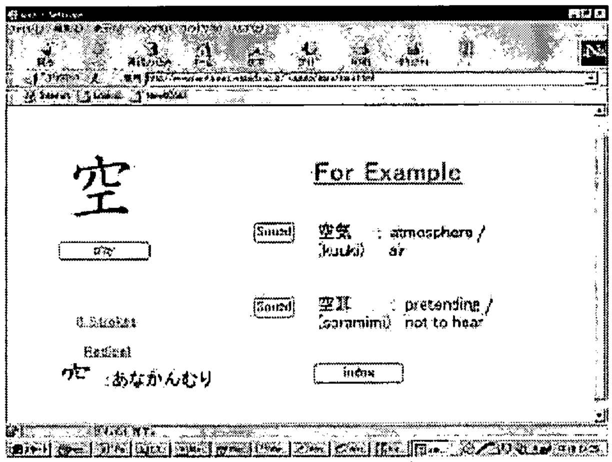

Figure 3: Database Module

5.2 Drill module

Our "drill module" includes two types of software. The first is dedicated to the learning recognition skills of the character. The second concerns the learning of writing skills. Software functions are co-ordinated and the student can practice a word through different stages. Furthermore, he can get information on the words through links to the "database module".

5.2.1 Drill for recognition skills, "Terakoya Web"

This software was presented as a stand-alone at the ED-media97. The student could get recognition skills by re-constructing a character randomly selected with a mouse to form a puzzle, (Fig.4), motivating his study.
In Japanese, some characters are similar in shape, while others are different in appearance from the fonts. (Fig.5) The student can be accustomed to recognize them by constructing their parts with his hand.

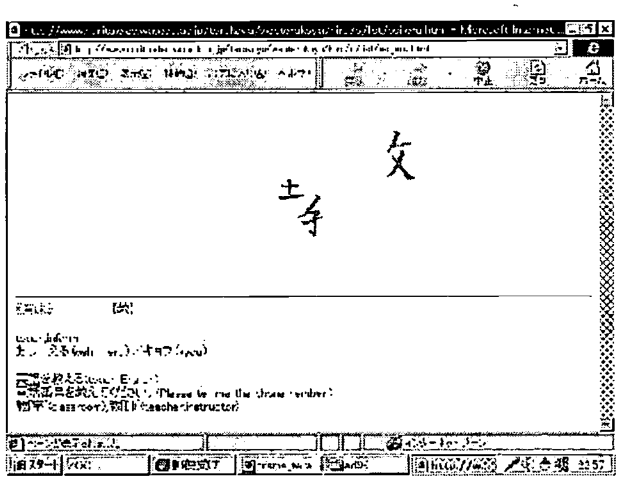
Fig4. Drill for recognition skill

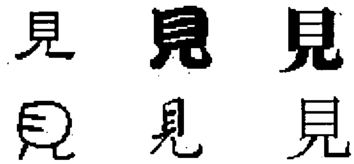

Figure 5: Difference depending on the font.

5.2.2 Drill for writing skills, "Terakoya Kanta"

This software has also been presented as a stand-alone at the ED-media 98. This software has been tested at the Richmond Primary School in Portland, Oregon and Waseda University Language Centre and has got a good evaluation.
The learner can practice the characters with a mouse or a tablet in this module, which advises and shows, like a real teacher, the score for the written character. Our software uses vector and stroke-rhythm information and can find wrong stroke order and other close points as "Hold", "Leap", "Sweep" and "Curve".
The learner can select the learning mode depending on his age or his level. Many animations and happy sounds are built-in for children as an option. This system can make the writing practice joyful.

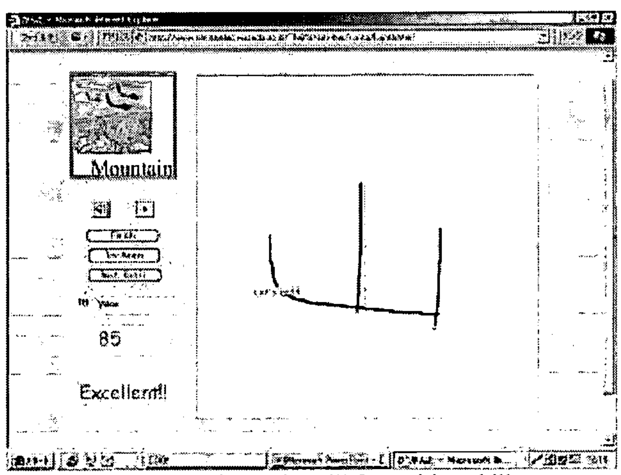

Figure 6: Drill for writing skill

5.3 Module for making drill.

As for the past works, the software of the database module can not be used for self-teaching and sometimes there are some differences between the contents of the database and the teacher's needs. Furthermore, only one person can use the software of the drill module at the same time and schools, which provide each student a computer, are the exception. Therefore we suggest that at first one or two students practice with the software in the presence of all students and then, that all students practice with a paper drill. A paper drill closely related to the drill software will be of great help to the students. To realize it, two functions are necessary.
The teacher can select the contents that he wants to teach from the database module, such as some pronunciations and usage of the word. Thereafter, selected contents should be shown in the drill module, which students do.
The teacher can print out the paper drill. That includes the contents, which the teacher selects.
Our system "Kanta" has these two functions.

6. Conclusion

Use of multimedia is one most effective way to learn a language. Because animation and sound, respectively samples of writing and pronunciation, will be a great help to master a language rather than paper or other media. Of course, we cannot ignore the motivation effect when using a computer. Besides, a much higher efficiency is expected when the learner utilizes the database module for reference.

However, such a system can hardly satisfy the needs of the Japanese education. One reason is the difficulty to teach Japanese on the base of its singularities. Most software we have found can train only certain skills, like recognition skills, writing skills or talking skills. Therewith, it is difficult to utilize them in classrooms because of the difference between what the teacher wants and what the software can produce.

To compensate these problems, we have integrated the database and the drill modules, allowing training recognition skills, writing skills and talking skills. This system is an integrated environment for mastering Japanese. The learner can find the information of a certain word in the database module, and then, can practice the recognition of certain words. At last he can try to write the word. For the use in class, the drill module can be customized according to the teacher's needs. The teacher can also prepare paper drills utilizing our database module.

Our system "Terakoya" is developed on a WWW base so that it can be used on any platform. We are preparing some options to achieve effective learning irrespective of the learner's age or aim to study Japanese. Our system can be used not only for self-teaching but also in classrooms.

7. Future works.

A network version of this system will be tested at Richmond primary school in Portland, Oregon and at Language Centre of Waseda University. (Stand-alone versions have already been tested and got a good evaluation there.) At present, we have a plan to develop a training module for idioms (Jukugo). We are also considering applying this system to other languages.

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The Effect of Continuous vs. Discontinuous Feedback in a Simulation Based Learning Environment

Guttormsen Schär, S., Schierz, C., Krueger H.
Institute of Hygiene and Applied Physiology
Swiss federal Institute of Technology, Zürich, Switzerland
e-mail: guttormsen@iha.bepr.ethz.ch

Abstract: The aim of the this study was to apply cognitive theory about two learning modes to HCI and to investigate the effect of feedback on user performance in a simulation based learning environment. The effect of continuous and discontinuous feedback was tested in an experiment where the subjects first learned principles of illumination ergonomics with a simulation. After the learning phase the procedural and declarative knowledge were tested. The experiment shows that variations in feedback had no significant influence on the performance and behaviour in the learning phase, but feedback had an effect on declarative knowledge and the users confidence in procedural knowledge. The conclusion is that the discontinuous feedback condition increased the declarative knowledge and the confidence in the procedural knowledge. The differences between the experimental groups can be explained, in that the feedback conditions induced different learning modes in the subjects.

Introduction

Interface design should be theory *and* effect driven. Theory should guide experimental research, rather than phenomenological interest in technological features. On the practical side, knowledge about the effects of user-interface features should guide implementation, rather than technological advances. Today, computing power is not anymore a limitation for implementation, the problem moves from how to implement to what to implement. This paper shall give a better understanding of the impact of theory for interface design, and a context for how to make decision for the implementation of different interface features.

This study combines both cognitive theory and software ergonomics. The theoretical background is drawn from the increasing evidence that people can learn in two different modes (Reber, A.S., 1989; Hayes & Broadbent, 1988). An explicit mode is recognised by a conscious and selective attention towards the problem, while in the implicit mode, the learning is more unconscious and trial and error based. The success of employing each of these modes depends on characteristics of the problem. Previous experiments have shown that different user-interfaces can induce the two learning modes, and that different user-interfaces influence how people learn (Guttormsen Schär, 1998; Guttormsen Schär, 1997a). By way of example, a command-based interface can induce an explicit learning mode, and a direct manipulation interface can induce an implicit learning mode (Guttormsen Schär et.al. 1997b; Guttormsen Schär, 1996). These studies showed a benefit for the explicit learning mode for intelligible learning tasks. A study was designed to investigate the effect of the interface when the differences between the interface features become subtle. How subtle can variations in the user-interface be, and still induce two different learning modes?

The software ergonomics in this study address decisions for the implementation of user-interface features. The effect of continuous and discontinuous feedback of the actions with a simulation was examined. With increasing processing power, continuous feedback to the user is appealing. The effect of this kind of feedback should be investigated in order to gain knowledge of benefits and eventual disadvantages for the user. An effect of feedback in this case would not only be related to aspects of the feedback itself, but would also indicate the degree to which users are influenced by apparently unimportant interface aspects in general. Two actual examples from commercial software illustrate different forms of subtle feedback. The two examples represent continuous and discontinuous methods of feedback respectively:

1) A graphics editor such as Adobe Photo-shop offers filtering options, which are operated by dialogue boxes. In the dialogue box, different parameters can be changed interactively by moving small handlers on a bar. The effect of a change can often be seen instantly in a small preview box. This gives the user an immediate impression of the effect of such a change.

2) The use of 3D programs often involves the following situation: when rotating a three-dimensional object, the user is actually manipulating a simple copy of the object, i.e. a 'bounding box'. The real object is first shown when the rotation is finished.

The theoretical question was whether continuous and discontinuous feedback of users actions can induce different learning modes in the user. The software ergonomics question was whether continuous or discontinuous feedback can be recommended for simulation based learning. The following hypotheses were tested in the experiment:

1) An interface with continuous feedback induces an implicit learning mode.
2) An interface with discontinuous feedback induces an explicit learning mode.
3) Discontinuous feedback results in a better learning effect.

Method

Subjects

24 subjects, between 20 and 39 years participated. The subjects were sampled from different study directions, both men (10) and women (14) were represented. All subjects were paid 30 SFr. None of the subjects had experience with the learning content of the simulation.

The Simulation and the Interaction

The experiment used an interactive simulation of illumination ergonomics for the learning task. The main mask of the simulation is shown in Figure 1. The subjects could install and remove luminaries in a virtual room, and they could move and rotate a working place. The effect of the actual illumination, i.e. the ergonomics evaluation of the illumination configuration was shown on six different scales displayed as bars: *amount of light*, *shadows*, *glare*, *screen glare*, *work place visibility*, and *general satisfaction*. Hence, the scales gave feedback about how the actual illumination and configuration of the room influenced a virtual person. The ergonomics evaluation applied a scale from 0 to 10, and was indicated on the bars by a ruler. In addition, the bars were colour coded: a good configuration made the rulers appear within the green area of the bars. The red area of the bars indicated a bad illumination configuration. The simulation was operated by 'direct manipulation', the subjects could perform all operations by using the mouse to click on buttons, select and drag objects.

Feedback

The feedback in this experiment was directly related to the user actions with the simulation. The calculation of the ergonomics evaluations could proceed in one of two ways: it could be displayed continuously with tracking actions or alternatively the ergonomics evaluations scales could be computed discontinuously and the scales would be updated only when the mouse button was released. In the continuous condition the bars indicating the actual value on the ergonomic scales would instantly move with the tracking movements of an object. In the discontinuous condition the subjects would only see the bars change from the last position on the scale to the new position after the object had been moved to a new position.

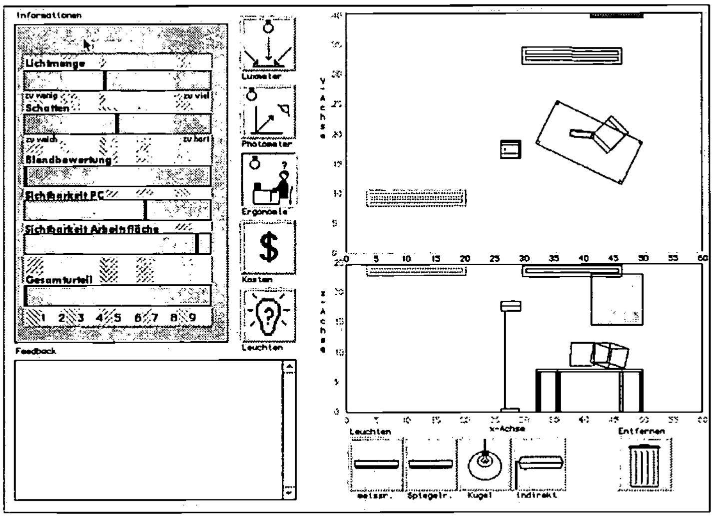

Figure 1: The main mask of the simulation

Experiment and Procedure

The experiment had a 2 X 5 mixed design, with feedback as the between variable and task as within. The independent variables were number of actions per task, total time per task, thinking time between each action, performance (i.e. total scores on the ergonomic scale), declarative knowledge about illumination ergonomics and subjectively estimated confidence in the knowledge from the post learning tasks.

Initially a test of the ability to use a mouse was administered. All subjects were required to complete a puzzle, which required precise positioning with a mouse. The time to complete the puzzle and thinking times were recorded in a log file.

In the learning phase, the experimental task was to create an ergonomic optimal configuration of the working place and the light sources (luminaries and window). All the subjects were required to solve 5 tasks. The tasks reflected variations in the external conditions in the room: the position of the window, and the conditions for the movements of the working place. The working place was initially positioned differently for each task. All the actions with the simulation, the effects on the ergonomics evaluation, and the time per action, were recorded in a log-file.

After the learning phase, 10 post-learning-tasks were administered to test the procedural knowledge of the subjects. The subjects were required to use the simulation to create an illumination configuration in the room. In these tasks the subjects could not see the ergonomic effects of their configurations. In five of the tasks the goal was to achieve optimal illumination evaluations, and in the other five tasks the goal was to achieve the poorest evaluations. After each task the subjects were asked to indicate on a scale from 1 to 100 how confident they felt that they had achieved the target, the objective ergonomics evaluation were not shown to them.

As a test of declarative knowledge, all the subjects were asked to write down their answer to a question, which was designed to measure the declarative knowledge about illumination ergonomics. The answers were evaluated by three independent experts on illumination ergonomics, who were uninformed about the difference in learning conditions during the knowledge acquisition phase. The mean scores of the experts were used as the measure of declarative knowledge for each subject. At the end all the subjects were asked to indicate on a five-point scale how difficult the learning tasks were, and how pleasant it was to use the simulation.

The experiment was run according to the following procedure: 1) Introduction to the experiment, 2) Direct manipulation test, 3) Introduction to the simulation, 4) Learning phase, 5) Post learning tasks + Confidence questions, 6) Questions about procedural knowledge, task difficulty, and user-preference towards the system.

Results

The learning phase did not result in any significant effects of feedback or interaction effects between feedback and task. There was also no difference between the groups on how difficult it was to solve the tasks or on user satisfaction.

In the post learning phase, a main effect of feedback was evident in the subjective confidence in achieving the goals of the procedural tasks, and in the declarative knowledge. These effects can be seen in Table 1. The procedural knowledge were not different between the groups ($p = 0.34$). The reliability between the three independent adjudicators evaluating the verbal knowledge was .86, which indicates an acceptable degree of agreement between the adjudicators.

Feedback	continuous	discontinuous	F	p
Confidence	75.33	83.56	20.28	0.0001
Knowledge	1.15	2.08	3.43	0.0783

Table 1: Effects of feedback in the post-learning phase

A main effect of the post learning task (target 'good' or 'bad') was found for satisfaction and confidence in the procedural knowledge. This effect can be seen in Table 2.

Task	good	bad	F	p
Satisfaction	7.35	2.68	179.25	0.0001
Confidence	75.89	83.00	15.82	0.0001

Table 2: Effects of post learning task

No sex dependent learning effects resulted in the learning phase. The mouse test revealed no significant differences between the groups. The results of the experiment can therefore, not be explained by biased distribution between the groups due to skills in operating the interface.

Discussion

The lack of effects in the learning phase (both on the interaction style and on the performance side) shows that feedback only had an effect on a deeper level. The effect of feedback is, evident by the post-learning tasks. The main effect of task (target 'good' or 'bad') in the post learning phase shows that the subjects succeeded in distinguishing the two targets. The differences in confidence of the procedural knowledge and the tendency of better verbal knowledge of the illumination principles, give reasons to conclude that continuous and discontinuous feedback can induce implicit and explicit learning modes, respectively. Hence, hypotheses 1 and 2 are supported. The cognitive theory predicts these effects. When learning in an explicit mode, people are expected to have explicit and rational reasons for their actions, while in the implicit mode the actions are more intuitive and difficult to verbalise. The negative effect of the implicit learning mode can be explained in two ways: either the illumination principles were not understood or the knowledge was cognitively organised in a way that made retrieval difficult. The latter explanation seems correct based on the fact that there were no difference between the group in the procedural knowledge for the post-learning tasks, i.e. both groups were able to employ the knowledge from the learning phase. Poor cognitive organisation of the learning material was reflected in the difference in confidence in the procedural knowledge between the groups. The subjects in the discontinuous feedback group solved the post learning tasks by relying more on explicit reasons, hence they also reported greater confidence in achieving the target. The effect of two modes of learning is also supported by the tendency of a difference in declarative knowledge between the groups. Learning in the implicit mode did result in procedural but not in declarative knowledge. The knowledge in the implicit group could not be verbally expressed as good as when learned in an explicit mode.

Hypothesis 3 was only partly supported because discontinuous feedback only showed to have a benefit for declarative knowledge and confidence. A stronger result would have been when the effect of feedback was evident for both procedural and declarative knowledge.

On the theory side, the results are in line with the conclusions of our previous experiments (Guttormsen et al. 1997b and Guttormsen, 1997a.) Guttormsen et al. 1997b applied an earlier version of the simulation used in this experiment. This experiment can therefore be seen as a replication of the effect of an explicit learning mode for tasks involving simulation based illumination ergonomics. When the subjects are encouraged to learn with more focused attention,

they are able to invent heuristic rules about the illumination principles, and to apply these rules. The more unfocused attention recognised in implicit learning, obscure the obviousness of such heuristics.

On the software ergonomics side, the results of the experiment may be surprising, because the difference between the feedback conditions was not large. There seems to be a tendency among software developers to not reflect much about the effects of such interface factors. A common opinion seems to be that it is good for the users to get fast feedback as long as computing power makes it possible. In this experiment it is, therefore, worth reflecting more about which practical effects the two feedback conditions actually implied for the subjects. In the continuous condition it is possible that the subjects focused their attention more on the ergonomic evaluation bars than on the actual configuration of the objects in the room. It was in principle possible to select an object and drag it without to look at the objects itself. Every mouse movement caused an instant updating of the feedback bars, hence the subjects could have been implicitly shaped to keep the attention on the ergonomics which navigated their movements of the objects in the room. In the discontinuous condition, the ergonomics values were only calculated and shown when a drag action was finished. Hence, the subjects could focus their attention more on the configuration of the objects in the room. The subjects in this category therefore have learned more about how to configure the objects in the room in order to achieve an optimal illumination and ergonomics evaluation.

Conclusion

Two aspects were addressed in this study: on the cognitive level, the applicability of cognitive theory to HCI was investigated, and on a software ergonomic level the question was whether subtle variations of the user-interface also have an effect on the learning performance. The experiment has shown that implicit and explicit learning modes can be induced in the users by means of continuous and discontinuous feedback respectively. The cognitive theory offers a background for explaining performance effects in the HCI context. This results in a more differentiated way of understanding HCI, as it incorporates the cognitive aspects. Traditionally in comparative HCI studies, the focus is on phenomenological aspects such as the user preferences or task completion times. Task completion time is a performance measure, which does not incorporate the quality of the achieved task solution. This study did not reveal significant differences in user preferences or task completion times. Hence, focusing on the cognitive aspects of HCI have resulted in a picture of the advantages and disadvantages of the user-interface that otherwise would have been ignored. The theoretical approach to an interpretation of user-interface effects is important in showing a more differentiated picture of the effects of various user-interfaces. The theoretical approach is particularly applicable to user-interface design in the computer aided learning context, where the aim is to acquire knowledge. The aim of a program is an important aspect, because the effect of continuous vs. discontinuous feedback could be quite different if applied to another context. Contexts, which are less focused on knowledge acquisition and transfer of knowledge to different task environments, may benefit more from continuous feedback. This may apply to tasks, which require creativity and possibilities to explore. The fact that the intervention by the user-interface was minor, but nevertheless induced different learning modes shows that users of software are extremely sensitive to any effect imposed by the user-interface. The advice for developers is therefore that even apparently minor user-interface features can have significant effects on performance and should be considered. All kinds of interface features should, therefore, be evaluated objectively in relation to perceivable advantages and disadvantages related to the task before they are implemented. Further research in HCI should continue to incorporate the cognitive aspects of using an interface, and effort should be put into investigation of differentiating aspects of user-interface technology.

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Information Retrieval and Visualisation within the Context of an Agent-based Information Management System

Lora Aroyo
Faculty of Educational Science and Technology, University of Twente, The Netherlands
aroyo@edte.utwente.nl

Darina Dicheva
Department of Computer Science, Winston-Salem State University, N.C. 27110, USA
dichevad@wssumits.wssu.edu

Abstract: AIMS is a knowledge-based information system whose main goal is to help users to deal in the most efficient way with information within a specific domain in respect to their preliminary defined tasks. AIMS provides the user with an access to the whole information domain presenting to him/her information search, exploration and navigation facilities. AIMS is endowed with an explicit conceptual mapping of the domain knowledge structures and a user model. Within the general system architecture of AIMS we will focus on Information Retrieval and Information Visualisation tasks and will present a solution to some of the problems in this respect.

Introduction

Although the task of searching and finding relevant information is quite an old one, nowadays it becomes very prominent due to the presence of the World Wide Web and constantly increasing amount of dynamic information available there. There are a number of problems that are encountered in respect to this current and extremely large-scale information context. They are mainly related to the searching, filtering, navigation and browsing tasks. In this concern the issues of how to increase the effectiveness of information retrieval and information visualisation are becoming essential for the information management in such dynamic and complex environments.

In this paper we present an approach to Information Retrieval and Information Visualisation that employs the use of Concept Maps for representing classification knowledge. The latter allows for more efficient information retrieval and clear and attractive information visualisation. We discuss a prototype of an Agent-based Information Management System (AIMS) that implements the proposed approach applying the Intelligent Agents technology. The reported work is performed within the framework of some masters and PhD research projects related to the use of Intelligent Agents technologies in Virtual Study Environments. We believe that a combination of agent technologies and visualisation techniques in the context of concept mapping has a very positive impact on effectiveness, efficiency and user engaging in respect to information use, reuse and maintenance.

Information management systems are proposed as a way to improve the usability and maintenance of information. In our project we envisage the management of information as concerning two mutually complementing processes: these of retrieving the right information and visualising it in the right way. Thus the focus of the work is on information search, retrieval and effective presentation to the user. The aim is to support the user in accessing, selecting and understanding the requested information. The main idea was to integrate several technologies that supplement to each other in respect to more effective information management within the framework of distributed environments. The technologies we consider include: intelligent agents (IA), information retrieval (IR), information visualisation (IV), concept mapping (CM) and user modelling (UM).

When we speak about Intelligent Agents we have in mind software components that support a user in accomplishing some complex activities (composed of a number of tasks) within information environments, such as offering, finding, and editing information. Each of the atomic tasks is performed by one or more agents who are presented as autonomous, goal-driven and sensitive software entities with abilities to learn, co-operate and react within complex environments (Travers 96). Intelligent Agents are used in the context of Information Retrieval that involves search strategies over large collections of documents and classification of the available documents. Concept Mapping is one of the main techniques used to support domain ontology (structures). It is a way of graphical representation of concepts and their relations (nodes - link formalism) or visualisation of the human-like knowledge representation based on schema and semantic memory models (Collins, Quillian 70). It is not a new knowledge representation language but just a way to use existing languages for more flexible and dynamic knowledge representation. An important issue among the ones already mentioned is Information Visualisation. There are two main goals for embedding information visualisation techniques within information search and management. The first is to facilitate users' comprehension and provide means for easy manipulation of large amounts of information based on ontological structures and ordering (Welty 98). The second one is to provide an easy to manipulate overview of search results that can make the search process more efficient for the user and that will support successive refined or new searches.

The paper starts with a discussion of the information retrieval and information visualisation issues and their implementation in AIMS. In the following section we focus on a short description of the AIMS prototype. The last part presents some conclusions and future perspectives.

Information Retrieval in AIMS

Information retrieval involves two main issues:

- effective search strategies over large collections of documents;
- appropriate classification of the available documents.

Search strategies concern efficient document retrieval in respect to relevance and recall of the obtained results and effective document retrieval in respect to computation. The efficiency here depends heavily on the document description model. Classification, on the other hand, concerns the design and implementation of a framework for development of multiple classification subsystems used in a single document retrieval system.

The information retrieval approach we propose is based on using intelligent thesaurus represented by the Concept Map technique. This thesaurus plays the role of an active information/knowledge dictionary that supports the domain ontology. It assists users in identifying similar, broader or narrower terms and expressions within a specific information domain and obtaining the assigned information. The classification scheme we use is based on conceptual mapping of terms and relations in a specific problem domain. Our choice is based on CM analogy with human mental structures and means of handling information. Such classification facilitates the dynamic adaptation of the system to changes in the domain. In addition, CM-based classification correlates efficiently with an user model presented also in the form of a concept map of user knowledge, preferences, styles, and tasks. The use of conceptual representation of the domain knowledge and information structure makes the system dynamic and provides methods for automatic manipulation of its information and knowledge. Classification in IR concerns grouping and selecting document descriptors by using document text, statistics, user feedback, document interrelation, collaborative filtering or other criteria. The *DoCS* (Document Classification and Search) model used in AIMS is keyword-based, where each document is described by a correctly constructed set of keywords. The model is defined as a 6-tuple:

DoCS = (D, K, T, Q, E, P), where:
D is the set of all documents in the database: $D = \{D_i \mid D_i, i \in N[1,n]\}$;
K is the set of indexed keywords used in the document descriptors: $K = \{k_i \mid i \in N[1,n]\}$;
T (thesaurus) is a set of keyword-synonyms pairs, describing the relations among the keywords in *K*:
$T = \{(k_i, S_{ij}) \mid k_i \in K, S_i = \{s_{ij} \mid s_{ij} \in [0,1], i,j \in N[1,4]\}\}$, where s_{ij} is the probability that the user would relate the keyword k_j to k_i;

Q (user query) is a set of coefficients specifying the document with its keyword relevant to the query: $Q=\{q_i | q_i \in N[0,1], i \in N[1,n]\}$, where $q_i=1$ when keyword k_i is part of the user query, otherwise $q_i=0$;
E (extended user query) is the set of indexed coefficients for the calculation of the relativeness of a document to a query, $E = \{e_i | i \in [1,n], e_i = \Sigma_{j=[1,n]} q_j s_{ji}, q_j \in Q, s_{ji} \in S_i\}$;
P is the set of pairs (document, keyword set): $P = \{(D_i, K_i) | D_i \in D, K_i = \{d_j | d_j \in R[0,1], j \in N[1,n]\}$. It presents set of coefficients (probabilities) that relate the keyword k_j to the document D_i by the value d_j. This is interpreted as the probability with which the user giving the keyword k_j would be satisfied by the document D_i.

The matching value for the user query Q and a document D_l is obtained by the formula:
$m(Q,D_l)=\Sigma_{i=[1,n]} e_i d_i$, where $e_i \in E$, $d_i \in D_l$.

AIMS document database includes an extensive term thesaurus that defines a special synonym relation in order to support more precise and effective search approximation and selection. Every keyword has a synonym or a list of synonyms related to it with specified weights. Thus if keyword K_1 is related to (is a synonym of) keyword K_2 with a specified weight, this weight can be interpreted as the percentage of the meanings of K_1 that match or are near to some meaning of K_2. When a user gives a search expression the system searches not only for the words in the expression but also for their synonyms. Synonym relation is defined as a full relation, which means that any two keywords are considered linked but some with zero weight.

The search procedure for a query includes calculation of the matching value for each document and sorting the documents by these values in descending order. The documents with higher matching value are considered more relevant to the query than the ones with lower matching value. This algorithm has a simple and efficient implementation by the use of RDBMS and SQL. A SQL query implementing the search procedure would look like this:

```
select d.id, d.title, d.type, d.url, d.description
from doc_keyword dk, synonym s, document d
where (d.id = dk.did) and (dk.kid = s.kid2)
and (s.kid1 in [qkid1, qkid2, ... , qkidm*])
group by d.id, d.title, d.type, d.url, d.subtype, d.description
order by sum ( dk.weight * s.weight ) desc
(* qkid1..m are the keyword ids used in the query)
```

The presented model supposes independence of the documents, the keywords and the synonyms at the stage of document search. This does not affect the generality of the solution since relations between different objects can be accounted at the classification stage. Some of the advantageous properties of the presented model are that it is easy to understand and easy to implement; the matching function is intuitive and natural; the search procedure is computationally efficient in regard to speed and storage; the refine procedure is efficiently implemented by adding new query keywords to the old ones and restarting the search procedure, instead of keeping huge quantities of data between the refine queries. Such refined search is more likely to produce relevant results then the standard ones, which use only the documents retrieved after the first search was initiated.

Information Visualisation in AIMS

Information visualisation supports user's thinking and comprehension processes by activating his/her visual thinking and memory. Visualisation techniques come to reduce mainly user's overhead of finding the needed information and supports algorithmic achievements in finding potential relevant items.

Visual displays in our work are mainly concerned with consolidating the search results into a graph form that is easily processed by the user's cognitive abilities and provides him/her with an additional information about the context of the retrieved results. The graph is presented with the means of a concept map giving the ontology of the domain under consideration. It is the main skeleton for organising, structuring and presenting the documents to the user. It contributes to the effectiveness of search activities by supporting both relationship-guided search for relevant information and its visual presentation. Thus the user is able to navigate through the information hierarchy and focus on specific portions of it but still within the context of the domain as a whole (Fig.1).

Within the AIMS prototype we have defined a Concept Map (a domain term network of structured and related concepts) that explicitly describes the domain structure and knowledge in the area of Courseware Engineering. All documents are attached to the concepts (domain terms). Each concept is a node in this map and is related to other terms with means of labelled relations. A customised set of standard, canonical labels defined by (Lambiotte, Dansereau, Cross, Reynolds 89) is used, which is proved to be useful in mapping of most academic and technical domains. The map provides a spatial arrangement of nodes and links to communicate about concepts and to specify the multiple relationships among concepts in a given information or knowledge domain. This helps the user to process larger numbers of document resulting from searches in shorter time, and to develop a clear view (mind picture) on the information domain: all terms available and their conceptual relations (Jonassen, Marra 96). This type of creative visualisation activates user's imagination by providing him/her with an additional knowledge, context, meaning to the information used. Visualisation of the user search is also quite important part in making the information processing more effective and easy for immediate analysis.

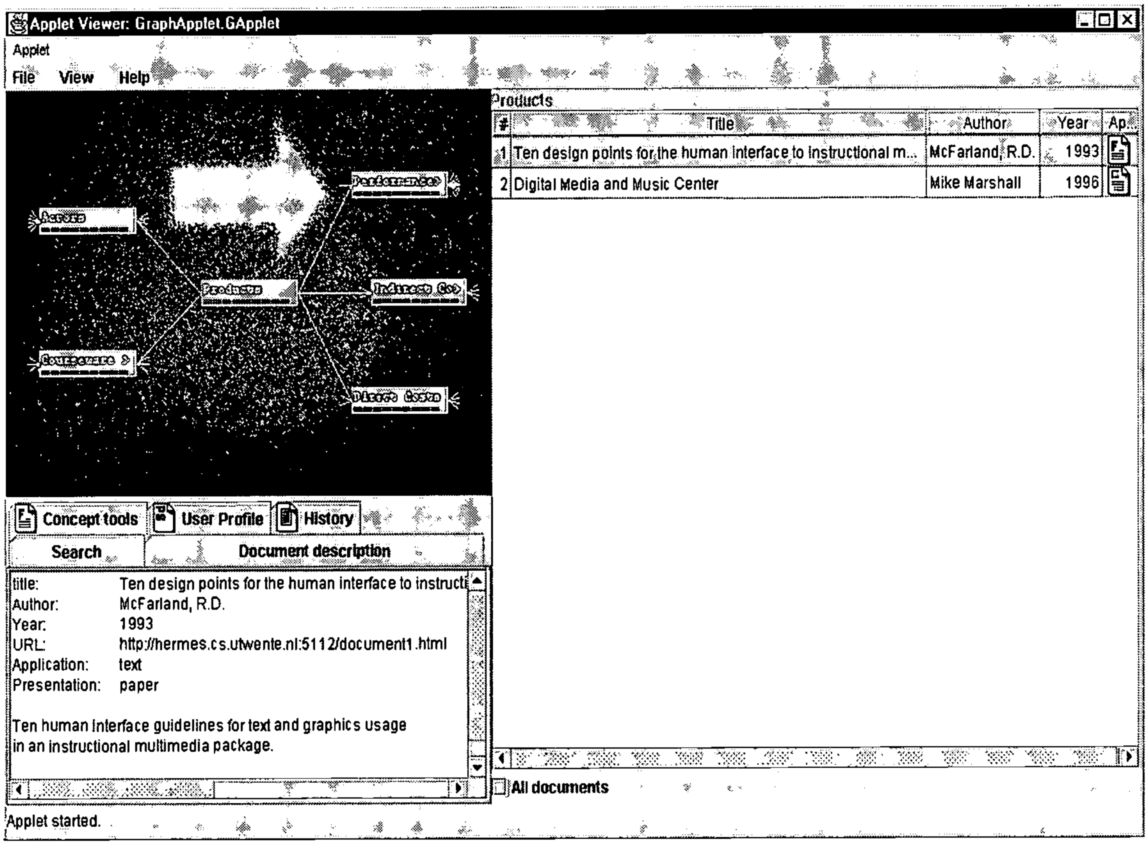

Figure 1: Interface of AIMS: display of search results.

AIMS: General System Architecture

In AIMS we take a social viewpoint to an information system, in which several agents interact by exchanging information, sending specific requests, offering services, accepting tasks, competing with each other for a task to be accomplished or even helping each other. Following this, the AIMS prototype was developed as an agent-based information environment for intelligent management, search and usage of distributed information resources. We look at information manipulation in complex information domains in a new way: we do not conceive it as a mere application of (simple) search engines to collections of information materials. We rather see it as a task that necessitates concise system architecture bringing together the main functional modules for manipulating collections of resources situated within a knowledge and information-sharing environment. A 3-dimentional architectural framework is applied employing multi-agent support for intelligent information manipulation over a visual representation of the information domain, and a conceptual organisation of information resources involving semantic mapping techniques (Aroyo, De Diana, Dicheva 98).

AIMS presents an attempt for integral solution for the organisational management of resources as they are available in a dynamic and constantly changing (electronic) information distributed environment. From architectural point of view the system is built as a multy-agent system. Agents perform different tasks, such as search, presenting the results to the user, user-modelling, etc. Each agent task consists of atomic sub-tasks. Agents have co-operation abilities (communicate with each other, change their behaviour depending on the user action), communication ability (exchange messages), activeness (could be active even when there is no clear user request). The primary task of the system is retrieving information and presenting the results to the user. The agents perform this working in parallel as separate but co-ordinated processes.

Three of the AIMS agents are related to Document Search, Classification and Visualisation task: the Search Agent, the Domain Expert (Classification) Agent, and the Interface Agent. The Search Agent employs the *DoCS* model to perform intelligent search activities over the given information domain. It receives messages that are well-specified queries and finds the documents relevant to those queries.

The Domain Expert Agent is responsible for a set of domain specific tasks, like maintaining the concept map of domain terms (add, delete, check, reorganise, etc.) and by doing this it is responsible for the changes going on in the domain database. Further automation of this agent module can lead to more sophisticated tasks in respect to learning and knowledge building.

The Interface Agent is responsible for the communication with the user. It visualises the information domain structures, search activities, and search results by presenting graphically different parts of the concept map. Its main task is to give the user attractive and effective information presentation in order to make the system more user-friendly and adaptable to single user profiles. In order to make it more natural for the user we have combined graphical representation of the concept map with textual presentation of list of documents related to each domain term in the concept map.

Conclusion

This paper presents an approach to effective and efficient information management by connecting together in one system intelligent agents, information visualisation and information classification techniques. We discuss an agent-based information system AIMS. The core of AIMS is a knowledge base containing the domain model, the user model and a set of rules for concept analysis, pattern matching and decision making. The different types of knowledge and information in the KB are presented and manipulated using the same Concept Map - based knowledge representation and reasoning techniques. This model allows organising the different topics around the key concepts (terms) of the domain. As a testbed we have developed a conceptual model of the domain of Courseware Engineering.

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Using the ALICE Virtual Classroom for Higher Education

Shwu-ching Young
Center for General Education & Center for Teacher Education
National Tsing Hua University, Taiwan 30043
scy@cge.nthu.edu.tw

Abstract: This paper documents the rationale of the design of the ALICE virtual classroom to support an undergraduate course on web literacy offered in 1997-1998 at National Tsing Hua university in Taiwan. It describes the ALICE project, in which students used a variety of WWW-based learning materials to supplement collaborative group learning. Major findings of this study reveal that overwhelmingly most of the students were satisfied with the use of the ALICE virtual classroom. ALICE was perceived by the students to be a very innovative, useful and openly accessible virtual classroom that met their different needs and allowed learning at their own convenience and without limitations of time and space. This study also identifies the characteristics of those learners who can get most advantage from using this new medium. Implications for web supplement design and the role of teachers, and recommendations for further research are also discussed.

Introduction

The advent of Internet technologies provides educators with exciting and alternative methods of delivering instruction to and communicating with their students. Integrating the World Wide Web (WWW) and the Internet in higher education is a trend nowadays, and it has been the focus of much research on instruction and learning over the past few years (Wells, 1992; Lai, 1997; Collis, Andernach, & Diepen, 1997; Roussos, Johnson & Leigh, 1997; Freeman, 1997; Oliver & Omari, 1998). The use of the WWW and the Internet in educational settings can be presented in a number of forms, such as information access, interactive learning, networked communication and information presentation (Oliver & Omari, 1998) or overall in a virtual classroom which represents all possible class functions on the Internet (Porter, 1997). According to a study conducted by Wells (1992), with its technological capabilities, the Internet has become an increasingly effective way for teachers to offer computer-mediated distance courses without compromising the quality of instruction.

Using Telecommunication Technologies to Reform Education

Over the past few decades, constructivism has attracted the attention of educators in every discipline. Because the hyperlink techniques of the Internet support the basic ideas and claims of constructivism, the advance of telecommunication technologies and the rise of constructivism have brought fresh ideas to school settings. Following constructivist views, educators have made schooling more student-centered: learning happens when students assimilate information based on their individual experiences, values, attitudes and beliefs. Constructivists believe that learning occurs most effectively in contexts; educators, therefore, should establish real-world-like situations rather than decontextualizing learning in an isolated schooling environment (Jonassen, 1991).

According to Gibson's theory of affordances (Gibson, 1977; Gibson, 1979; Gibson, 1986), different types of instructional materials encourage or afford different types of activities. The affordances of the advanced telecommunication technologies on the Internet make a computer-supported real-classroom like learning environment available. Studies (Sun & Chou, 1996; Freeman, 1997) indicate that the use of Internet technologies with the affordances of multimedia presentation could provide learners with a more creative and innovative interactive learning environment in which flexible and alternative modes of content were delivered. Multimedia-based Internet courses could accommodate various kinds learners preferred mode of learning, such as hands-on learners, traditional learners, visual learnersc. If the courses on the Internet are well designed, they could offer learners a wide range of choices, so that learners could find the right mix of interaction and learning style to enhance their individual capacity to learn.

Description of the ALICE Project

ALICE, an acronym for Asynchronous Learning in Interactive Computer-network-supported Environments, is a research-instructional-oriented project funded by the National Science of Council (NSC) of Taiwan. It is basically a virtual classroom created on the Internet. The ALICE system intends to provide a rich, interactive and collaborative setting used to enhance learning and interaction for an undergraduate course on web literacy offered in the Center for General Education.

Based on the constructivist views of instructional system design in both concept and construction (Lebow, 1993; Jonassen, 1997), ALICE aims to be an inviting environment that integrates four major principles as follows:

A familiar distant interactive learning environment that is similar to a traditional classroom setting with the integration of computer networks, multimedia presentations, data bases, and the like;

1) A student-centered, openly accessible channel that encourages and supports students' active and self-regulated learning processes and that accommodates the needs of their personal learning style;
2) Both a well-structured and ill-structured environment that on the one hand provides the learner with a course pre-organizer, such as an on-line syllabus and rich and digestible domain knowledge in web applications; and on the other hand allows the learner to flexibly hyperlink and explore issues related to networking computer applications in learning and living;
3) An interactive and collaborative environment that provides settings for a community of practice (Lave & Wenger, 1991) through engaging and dynamic interactions in sharing information and knowledge between students and teachers and among students.

The ALICE virtual classroom is secured with the use of students IDs and passwords. Some pages, such as Bulletin Board, Conference Area, and Assignment, use forms and appropriate CGI scripts at the server end to manage the interactive messages. There are eight components in the virtual classroom, including:

1) Bulletin Board: providing learners with the most recent announcements;
2) Syllabus: including the rationales and goals of the course, tentative course schedule, weekly assignments, criteria for grading, required and suggested readings;
3) Instructors: presenting the instructor's personal background information, such as photos, degrees received, academic and research interests, correspondence;
4) Students: connecting to individual and group students' homepages that contain rich and various presentation styles;
5) Conference Area: allowing students and instructors as well as system masters to communicate with, post, share, reflect and discuss what they have browsed on the Internet. It expands the nature and scope of themes originally designed for the course;
6) Assignments: allowing each group to post their group discussion, reports and final projects;
7) On-line Readings: uploading weekly related reading materials in text-based, multimedia-based or powerpoint-based electronic forms;
8) Network Resources: linking to related web sites in order to fully utilize the rich resources on the Internet.

Methodology

1. Purpose of the Study

The purpose of this study was to investigate possible uses of the ALICE virtual classroom to support learning and instruction on an elective Web Literacy course in general education. The study sought to investigate answers to the following sets of questions:

1. What were the perceptions of students to the use of the ALICE virtual classroom as an information source and alternative environment to support learning?
2. Are learning styles, access to ALICE, and prior computer knowledge and experience important factors? What were the factors affecting the attitudes of the students towards computer-mediated discussion? What were the characteristics of learners who chose to take this course?
3. Did the use of the ALICE system support collaborative learning?
4. What challenges could a teacher be confronted with in using advanced technologies to support instruction?

2. Research Design and Data Collection

This study was conducted using both qualitative and quantitative research methods. The primary data collection methods included the use of observations, formal and informal interviews, and two sets of pre- and post- survey questionnaires which were administered to students to solicit information on demographic data, attitudes and prior experiences and knowledge toward computing network technologies. Observations were conducted weekly during class time in 16 weeks. The researcher kept field notes and reflexive notes immediately after each observation. Meanwhile, notes taken from informal interviews served as an adjunct data source. In addition, traffic on the web site was logged. The Webtrend program was used to analyze the traffic and provide summary access information on all of the files/pages presented at the site. Messages posted to the Conference Area were analyzed to examine the patterns of communication.

Triangulation was used to improve the probability that findings and interpretations found would be credible. Multiple sources of data verified that the data collected in the survey were consistent with what was being said in the interviews and observed in classrooms. Data were collected, transcribed, reduced, coded, categorized and analyzed in response to the research questions.

3. Participants

Participants involved in the study were 54 undergraduates, 49 male and 5 female students, enrolled in an elective general education course entitled "Computer Networks, Learning and Living". They were from 6 colleges (Science, Engineering, Electrical Engineering and Computer Science, Nuclear Science, Life Science, Humanities and Social Sciences) of a northern national university located in Taiwan. Their grade levels ranged from undergraduate freshman to senior.

4. Instructional Setting and Course Delivery

"Computer Networks, Learning and Living", a 3 credit-hour course, is basically an interdisciplinary course designed for learners from different disciplines. The purpose of this design is to get students from a variety of backgrounds to share and contribute their thoughts or techniques on web literacy from various perspectives. In addition to a weekly class-based two-hour seminar, the course places a great emphasis on the use of the ALICE virtual classroom, so that participation on the Internet counts for one credit hour. This pedagogical strategy was employed to increase students' involvement on the Internet.

All of the related information and reading materials were stored on the Internet. No handouts were distributed at the weekly class seminar. From the outset of the semester, students were requested to form 10 groups on a voluntary basis, and a mix of academic backgrounds and different computer experiences in each group was highly encouraged. Since this course was designed for collaborative learning, group scores were a big proportion of each individual's grade. The students were given a series of questions and activities to guide their readings and inquiry. Students were required to use the resources at the ALICE virtual classroom and other web sits to answer the questions and prepare for the group discussions, which formed the basis of the classwork each week. Each group leader was responsible for the postings of the group reports on the "Assignment" interface for critique.

Furthermore, students were directed to seek out new resources and were required as part of their course to recommend 10 relevant web sites with personal comments which represented a student's summary or impression of the information presented at the site. At the end of the semester, each group was required to complete a theme-based homepage project. Collaboration enabled them to learn about homepage production by HTML, Photoshop, GIF Construction, or CGI script. Each student was expected to have interactive hands-on learning experiences through a community of practice (Lave & Wenger, 1991).

Preliminary Data Analysis and Results

1. Students' Perceptions of ALICE

Major findings of this study reveal that overwhelmingly most of the enrolled students were satisfied with the use of the ALICE virtual classroom and were positive in their responses to questions regarding the value of information obtained from the links provided weekly. Feedback from the students indicated their love of the image of ALICE borrowed from "Alice in Wonderland" created by Lewis Carroll in the 1860s. They enjoyed the new interpretation as ALICE in Modern Wonderland--Cyberspace. Yes. It was expected that every student would become a happy ALICE and learn through the Internet. According to the students, ALICE was a very innovative, useful and openly accessible virtual classroom that met their different needs and allowed them to learn at their own convenience and without limitations of time and space. However, some students remarked on the frequent instability of university server systems and difficulties in accessing the virtual classroom when traffic might be heavy in the daytime. From the students' traffic patterns collected from the ALICE virtual classroom, it was found that students who possessed personal computers had more convenient access 24-hours per day than those who did not.

2. Who Can Benefit from ALICE ?

According to the data gathered from the questionnaires, among the 54 enrolled students, 49 (91%) were male students and 5 (9%) females. Referring to the undergraduate population of the same academic year of 1997-1998, the ratio between males (total 2601) and female (total 1073) was 2.6 to 1. Obviously, female students were underrepresented in this course. Their self-report data showed that 100% of the enrolled students had prior computer experiences, ranging from beginner to expert. Most of them claimed to be at intermediate level. When looking at students' academic backgrounds, we found that the distribution of their College origins was not even. 52% of the enrolled students were from the college of Electrical Engineering and Computer Sciences and the rest, 48%, were from College of Science (19%), College of Engineering (11%), College of Nuclear Science (9%), College of Life Science (7%) and College of Humanities and Social Sciences (2%). Consequently, students (52%) from the College of Electrical Engineering and Computer Sciences had strong interest in taking this course, while the lone student (2%) from the College of Humanities and Social Sciences expressed the least interest. In several interviews with students of College of Humanities and Social Sciences who dropped out of this course, they unanimously expressed their opinion that the course was difficult for them because they got stuck and frustrated on hearing a lot of terminology about the Internet at the first two weeks. Actually they did not use computers in their daily life. Lack of comfort and confidence with the computing technologies was the main reason given for dropping out.

3. Challenges to the Role of Instructors

The data collected from the instructor's field notes indicate that in addition to the weekly two-hour class seminar, the instructor had to spend an extra six to ten hours per week at the virtual classroom. In order to keep tracking students' weekly learning and their participation, the instructor spent large amounts of her time attempting to interact with students' email and WWW postings on the Conference forum and read through or visited related materials or web sites as recommended by the students. Ironically, the benefits of the Internet to the students could become an enormous burden to the instructor. Accustomed to the use of telecommunication technologies, such as e-mail and BBS, younger generations are gradually conditioned to get instant reply /feedback. If timely replies were not given, students expressed their impatience.

Offering web-supported courses is not an easy job for the instructor in terms of web course design, time involvement, system maintenance and so on. First of all, it takes extra time and efforts to create a web environment and design multimedia courses on the Internet. Along with the attributes of the new medium, such as high efficiency in communication and open access and interactivity, using the Internet for instruction is more labor intensive and time consuming. The role of educators is changing with the integration of modern technologies. Instructors in this computer-network-mediated instructional setting are becoming facilitators and learners as well. Because the technologies advance at amazing speed, instructors are actually learning from their students, particularly the technical aspects of advanced computing technologies. Instruction and learning are occurring at the same time.

Summary and Conclusion

The design and implementation of the ALICE virtual classroom to supplement a conventional course provided expected outcomes from the students' side but also several unexpected challenges to the instructors. This study indicated the appropriate integration of the Internet could produce real learning but not virtual learning only, as claimed by Ashworth (1996). Originally, the purpose of this course was to integrate the ALICE virtual classroom with teaching about web literacy for students from diverse backgrounds. This study supported our contentions concerning the potential of ALICE to provide more innovative, motivating, engaging, useful and convenient learning opportunities for the enrolled students even though at times ALICE as an information source proved frustrating and annoying to learners on several occasions when the server was down or the information could not be easily retrieved. However, the findings also revealed a numbers of factors which served to hinder learning opportunities for a certain group of students. For example, female students and those students from backgrounds in Humanities and Social sciences were underrepresented in this course. They, in general, lacked of prior computer experiences and were not confident and comfortable in taking computer-related courses. It is important to take these factors into consideration for future course design and offerings.

Incorporating advanced technologies into an existing learning environment can be an exciting but challenging task. How to help students learner better and more effectively, supplemented by advanced technologies, and how to make teachers enjoy giving the course without experiencing too much stress--these questions deserve further study from the aspects of instructional design, teaching load, intellectual property on the Internet, teacher training and logistical support.

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Enabling Professional Learning in Distributed Communities of Practice:Descriptors for Multimedia Objects

Christine Steeples
Centre for Studies in Advanced Learning Technology (C SALT)
Lancaster University, Lancaster, UK
C.Steeples@lancaster.ac.uk

Peter Goodyear
Centre for Studies in Advanced Learning Technology (C SALT)
P.Goodyear@lancaster.ac.uk

Abstract: This paper explores how the use ofmultimedia communications technologies to enable elements of real-worldworking knowledge, that are tacit andembedded in working practices to be rendered into shareable forms forprofessional learning. Communications technology offers innovative ways forgeographically distributed professional communities to create, annotate,discuss and reflect upon multimediaobjects that capture working practices, such as problems of practice. Thepaper reports on work-in-progress on multimedia objects (primarilydigitised videoclips). Use of multimedia in professional learning isrelatively novel, and it is surfacing issues about the requirements for creating shareable, effective representations.Descriptors for multimedia objects have been developed and the paperfocuses on applying the descriptors to an example videoclip. The durationof the clip, it's use of artefacts and the social cues in the clip are considered key factors in creating ashareable representation for discussion and reflection in distributedprofessional communities.

Introduction

This paper concerns asynchronous collaborative multimediaenvironments used to support professional development; to enable key elements of real-worldworking knowledge, that are tacit and embedded in working practices, to berendered into shareable forms for improving working practices and forprofessional learning. We believe multimedia communications technology can offer innovative ways of: a)capturing rich examples of working practices (and the tacit knowledgetherein); b) rendering the examples into communicable objects; c) sharingand subjecting these objects to close scrutiny within a community of learners; and by so doing d) create authenticexperiential and reflective environments for learning.

Real-world practice as performed by professionals is highly complex.Skilled practitioner performance is underpinned by contextualised andvocationally-relevant knowledge (eg Schön, 1983; Lave & Wenger, 1991). This situated knowledge, tied to anddeveloped through practice, is considered highly valued for improvingactual working practices (Cervero, 1992; Koschmann, 1996). It is part of what shapes a community of practice and helps makes it an authentic'arena for learning' (Barab & Duffy, in press). However, since thisknowledge is tacit and embedded within practice, it can be very difficultfor practitioners to describe and share their knowledge (especially in a written text), without making an extendedaccount of the context, tasks, etc. Schön (1987) has argued by observing and reflecting on action, it is possibleto reveal the tacit 'knowing' implicit in 'doing'. This paper describes a new approach to sharing real-world knowledge for learning aboutprofessional practice: an approach that exploits asynchronous multimediacommunication technologies.

There are three key elements to this approach. Firstly, multimediatechnology enables us to capture (eg in video clips) rich and vivid examples ofpractitioners engaged in real-world practice. Secondly, the communicationstechnology enables the captured examples (or multimedia objects) to beshared and discussed among distributed professional communities. Not least, the asynchronous medium means the objectsand discussions can persist for revisiting, for reflection, and they can bemade available to other, especially newer members within a community.

Next, the context for this research is described and the kinds of representation that might be captured in amultimedia object are presented. The paper focuses on the creation of justone kind of representation, making use of descriptors to classify and tohelp understand key aspects in the multimedia object.

The SHARP and Voice Annotation of Multimedia ArtefactsProjects

This paper reports on two discrete but related projects: (i) aEuropean-funded project, SHARP (SHAreable Representations of Practice).SHARP concerns pedagogical and organisational aspects in the use of asynchronous multimedia conferencing(AMC) (see also SHARP Project Team, 1998); (ii) an ESRC (UK's Economic andSocial Research Council) project, Voice Annotation of Multimedia Artefacts.This project explores multimedia communications technologies used for reflective learning from group basedtasks.

In both projects, we have developed example video clips to help builda conceptual model, and as a way of simplifying and ordering the space ofpossibilities within which continuing professional development might occur when using distributedmultimedia communications technologies (Goodyear & Steeples, 1998)

Kinds of (video) Representations of Practice

Three broad categories and six potential 'kinds' of videorepresentation of practice have been identified. The distinction between*kinds* reflects their distance from the purity of a working practice, occurringin (non-observed) normal conditions. They therefore represent instancesalong a continuum from near-pure, through degrees of abstraction, to a wholly artificial rendering of practice. (see alsoGoodyear & Steeples, 1998). The broad categories include:

Near pure representations eg 'fly on the wall', and 'thinkaloud' or 'concurrent verbalisation'. To illustrate, we use theterm 'fly on the wall' for video clips which are, in some sense, 'raw'representations of practice: clips generated by techniques which TVdocumentary makers call 'fly on the wall', because the camera - and thefact that a representation is being created- are meant to have no significant disruptive effect on the practice.

Action with commentary representations eg 'commenting whiledoing', 'talking head', and 'prepared script'. Clips which we call 'actionwith commentary' are those in which the practitioner uses the voice track to a video representation of an unfolding practice,as a way of making that practice more comprehensible to others

While'near pure' representations may seem intuitively appealing as ones mostlikely to capture the *essence* of practice, trial work has revealed important difficulties in adopting such anapproach. For any kind of extended or complex practice, many hours of videowill likely be produced, requiring skilful editing. This suggests thesekinds of representation have a number of major limitations, not least in terms of their cost effectiveness. Incontrast, 'action with commentary' kinds appear to have a useful balance ofstrengths over weaknesses. They can still be firmly rooted in real worldpractice, but created without unduly excessive demands upon practitioners.

Descriptors for multimedia objects

To help make sense of representations, a set of descriptors can beapplied to multimedia objects. A four-way partitioning of the descriptorsis made under the headings of 'substantive', 'communicative', 'technical' and 'social' aspects. Figure 1below summarises the descriptors. The descriptors help to make sense of thevariety of factors that can be applied when describing a multimedia object.The descriptors help when looking in detail at exemplar (video) objects, to identify relationships betweenthe descriptors and to look for particular patterns emerging betweendescriptors. A brief outline is given below for the descriptors, using theterm 'subject' to denote the practitioner.

Substantive	Communicative	Social	Technical
• Nature of practice • Visibility Temporal extent • Involvement of artefacts • Role/status	• Intent • Audience awareness • Discoursemoves • Use of artefacts • Completeness	• Number • Gender • Role • Status •Cues given	• Method of capture • Duration •File size and format • Richness in form •Output provision

Figure 1:descriptors for multimedia objects

*Substantive*aspects include looking at the nature of the practice itself: eg what it isabout and whether there are sub-activities; who is involved; where ithappens; its frequency, etc. Substantive descriptors also include thevisibility of the practice especially if it is primarily a cognitive task,where little visible activity would normally occur. The temporal extent of the practice also needs to be considered.For example, the practice may last just a few minutes, or it may extendover weeks, even years. It may be important too, to examine the practice'suse of artefacts which might assist in the process of referential anchoring (Resnick, 1993) and thus may actas cognitive aids and help in communication about the practice (Säljo,1995). The subject's status/role in the practice may also beidentified.

Communicative aspects are those thatmake the object communicable and shareable. 'Intent' concerns thesubject's purpose in creating the representation, eg to show a practicebelieved to be of value to others, or to seek help, or to demonstrate aspart of an ongoing discussion. Communicativeaspects also include the extent to which the subject is aware of anaudience when making the video clip, and whether the subject draws uponartefacts to help give an explanation. 'Discourse moves' classify thelinguistic form of the representation eg as a question, a statement, a disagreement, etc. We are also interested inhow 'complete' an object might be, or whether it is reliantupon later elaborations, such as in an annotation, to render it intoashareable form.

Social aspects are primarily suggested for objects involving more than one person, where we might identifyaspects of group dynamics (such as gender and status) in multimedia objects. (Eg, of a video clip we might ask 'what is it about the way this groupwork together and the roles they adopt that helps create a thought-provoking representation of practice?').'Social cues' relates closely to communicative aspects, but concerns theextent to which the subject uses language, action or voice tone to suggesta sense of community, eg by inviting others into a discussion.

*Technical*aspects relate to the specifics of creating theobject including the method and management of capture.. Technical aspectsalso include the object's file size and its duration. Duration is likely tobe critical in determining the usability by others of a clip. Technically, the clip can also bedescribed in terms of its richness in form, ie whether it includes movingor still images and/or voice. Output provision will describe thefunctionality offered to users to control the play, eg whether the clip can be replayed, if play can be halted,moved back and/or forward, etc.

Applying the descriptors to an example multimedia object

In this section an example video clip, created with a practitioner inthe educational/training technology field, is examined using the descriptors for multimediaobjects. The reader may find it useful while reading this paper to look atthe clip on the SHARP website at:http://www.lancs.ac.uk/users/edres/research/sharpdemo/multimed.htm

Explaining a problem of practice

This video clip is used to explain and reflect on an authenticwork-related problem. In terms of *kinds* of representation, wesuggest this clip falls within the family of 'action withcommentary', and is closest to a talking head kind of clip. In this case the subject, Sonia, is using a computer program todesign and develop a paper-based A5 booklet. Sonia encounters this task anumber of times each year, but not sufficiently regularly to expendtargeted effort in learning how to cope with it in more time-efficient ways. The problem is usually met whenworking to a deadline, when it is essential to be working directly on task,rather than learning how better to use the tool.

Sonia explains to camera, using a booklet to demonstrate aspects of the problem. The clip provides a relatively easy way to show asshe talks. She can draw upon (and show) an actual artefact in ways that areinherently easier than if she were to create a text description. Thecapture method assists the communication process. The listener/viewer can see the artefact under discussion aswell as to hear/watch the explanation. The audience can see Sonia, hergestures or movements and hear her voice (including the changing tone ofher voice). The method of capture therefore has potential to assist the audience in making sense of Sonia'sproblem. The clip is prepared with an audience in mind.

Analysing the clip for relationships between key descriptors

The example video clip is a relatively generic problem of practice,sufficiently germane for widespread recognition by people accessing ourwebsite. It is distinguished by at least three key features, discussedbelow.

The duration of the clip and the richness of its form

It took just two minutes to prepare the clip, which lasts exactly 79 seconds. Beyond editing the start and finish of theclip, the recording was continuous and nothing has been changed. Ittherefore represents a concise yet coherent account of the problem, whichhas taken little effort or time in capture.

The duration over time is an interesting factor to probe further. Inthe 79 seconds, the subject speaks 180 words and makes 5 other utterances('ums'), which equates to 2.27 words per second. We made a rough andready, quick comparison by creating anaccount of the problem, in a textual message. This was similarly done "onthe fly" by one of our research team who was familiar with the content ofthe clip and who uses a word processor daily. In the test, it took 150seconds, to create the text and in that time 120 words were typed. No time was spent on correcting spelling orediting the message. On completion it was observed that the text messagehad taken almost twice as long to achieve, and though it does create acomparable description, it fails tocomment on three aspects that are spoken of in the video clip. Figure 2 and3 below illustrate respectively the transcript of the video clip and thetest (text) message. While a strict and rigorous comparative analysis isnot suggested between the two, the limitations of the text are apparent. It fails to capture the richnessof the clip: we do not see the subject or artefact, nor hear thesubject's voice and cannot see her gestures and references to the artefact. Andit does takes longer to create.

OK Ihave a problem in producing documents in A5 format like this. I do thisin Word.
I know there are other packages that would be better um such asPagemaker, would be better tools for doing this, such as Pagemaker but forvarious reasons I do this in Word.
I do it about four times a year and the problem is having a goodformat that enables me to number the pages in some automatic numbering way.
The way I do it currently is just to type in the page number and I workout by drawing diagrams um which page needs to be opposite which page so um page 2 is opposite page 11 and it carrieson like this in a way that is not immediately obvious. And each of thesepages is a page um within Word, divided into columns
It's a two column page, um, and it's a really clumsy way to do it andI know it's a clumsy way to do it, but I haven't thought of a better way todo it. So that's my problem

Figure 2: transcipt of the audio track on the video clip

Duration will also becrucial to the audiences for multimedia objects, such asvideo clips. Since video clips are inherently linear and sequential (inboth visual and aural terms), attention to their content is likely morelimited than attention to a text that can be visually scanned. Yet, theclip's *persistence* as a stored object and the control and playback provision provided couldprove influential for improving the *viewing* of multimedia objects ieto enable new forms of visual/aural scanning.

In time, voice technology will enable rapid, easier creation of textmessages. It is also widely suggested that the creation of text-based accounts promotesdiscursive and reflective representations, considered beneficial for'deeper' processing (eg Laurillard, 1993; Mason, 1994). We do not discountthe value of reflective text messages for learning, but the anticipated ease of use will not overcome the lack ofvivid, rich content *and* the support for social cues that areintrinsic features of multimedia, and requisite for 'showing anddoing' in professional learning

My problem concerns using a word processor, Word to creatbooklets such as A5 booklets.
I use word to do this but I know it would be better using a desktoppublishing package.
The problme concersn pagination of the pages.
In Word I have to splkiut an A4 pages into twocolumns and number the pages maually to get the right pages next to eachother in the final prionted document
because you need to have an oder that is notimmediately obvious such as page 19 being opposite page 2 so thats myprobmlem and I know I hanbndle it in a clumsy way
but there's never seemed an easier way to do it.
I hope you can help.
***Omissions from the text:** does not comment on number of times peryear doing this task; does not mention Pagemaker; does not mention drawingdiagrams*

Figure 3: test tocreate the same message using text

Use of artefacts as 'cognitive aids' and to 'ground' the representation inpractice

We believe the use of artefacts in video representations will beextremely valued for aiding the demonstration and unfolding of a practiceand for ensuring the clip is faithful to real-world practice and not anabstracted theoretical justification of it. A practitioner who is calledupon to describe their actions, without the referential anchor(s) of theartefacts used in, or produced from,the practice may well describe, in abstracted ways, the theory, rules orideals that are the starting points for their actions. The use of artefactshelps the practitioners' descriptions and explanations to be grounded inthe reality of their actions. In the clip Sonia makes verbal and (physical) visual reference to the booklet.She uses it to help *her* to explain the problem. The booklet is central to her representation; toextend her use of language. It mediates between thought processes and herspoken word. The booklet helps ground the explanation in the reality of thepractice. The artefact is also a mediational tool for the audience: to helpthem understand about and relate to the represented practice. It is avisible object that helps in creating a picture of a socially meaningful activity, among a community's members.

The artefact can also mediate between us and reality, in terms oftime. In this clip, the booklet (alongside Sonia's explanation) enablestime to be transcended. The clip shows the finished booklet and we hear about the pagination problem: we do not have towitness every stage/process in the booklet's development. Thisoffers timesaving opportunities by temporally delimiting the representation.

Social cues to the community of practice

Future working in *distributed* professional communities will probably mean many of its members will nothave physically met, yet we believe it will be important for learning insuch communities that there is a sense of identity and trust between themembers. Visual and aural aspects of the clip will help establish the community.Within Sonia's clip, through the images and sound track, we gain a sense about her. Wecan see what she looks like, hear her voice and gain a sense of her ways ofdoing. She suggests trust by confiding about her problem- eg in her reference to the "clumsy"way she currently performs this task. Sonia gives cues to her audience, toencourage responses from other members of the community. She is invitingothers to express their views or to offer advice

The duration of the clip and its richness in form, its use ofartefact and the social cues within the clip we suggest distinguish thisclip. Yet there is nothing inherently unusual in it that cannot bereproduced in other clips of practice. This suggests to us that video representations do offer innovative,vivid yet effective means for sharing in professional communities, whichwarrant further investigation.

Future work on annotating representations, especiallywith audio

'Near pure' video representations seem intuitively to suggest themselves for capturingpractice in near-authentic ways, yet if we want to stay closer eg to fly onthe wall kinds of clips, we see a rising importance to add annotation(s) tothe base representation, thuscreating complex multimedia objects. In our project work we will createvideo, voice and textual annotations to video clips. We are particularlyinterested in the use of stored voice annotations, to add to and toelaborate upon the video clip. We believe the use of persisting voice messages will offer new and effective ways toencourage professionals to articulate ideas about their working practices(Steeples, 1995). The video clip provides a direct and demonstrable exampleof practice in action, while making a voice annotation allows the subject to offer further (such asbackground or explanatory) information. Voice annotations will be used toencourage practitioners to explain their practices and also to reflect uponthem.

Summary

Thedevelopment of technologies that enable recording and digitising of multimedia artefacts(video clips that can be elaborated with video, aural or textualannotations) offers a radical departure for the design and use of onlinelearning environments. Multimedia technologiesoffer innovative ways to allow practitioners within distributedprofessional communities to create and share representations of problemsderived from real-world practices.

The next questions to consider in our work will include about thekinds of things that come to light when people are put in a position where they have tomake translations between tacit and discursive forms of knowledge. We arealso concerned to understand the kinds of translations people make whenthey have to talk about materials theyhave encountered in multimedia/video rather than in a textual form. Thework outlined in this paper will also be subjected to further scrutiny inforthcoming user trials, and will lead to a setof guidelines on bestpractice for using multimedia communications technologies in continuing professional development.

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An Investigation of the Development of Dialogic Approaches to Teaching and Learning in Schools Through Interactive Television

Terry Evans, Elizabeth Stacey & Karen Tregenza
Faculty of Education, Deakin University, Australia
tevans@deakin.edu.au; estacey@deakin.edu.au; karent@deakin.edu.au

Abstract: This paper draws on the ideas underpinning a two year Australian Research Council Large Grant project which explores the extent, nature and problematics of creating and sustaining educational dialogue through interactive television (ITV) in schools. ITV has been introduced in many schools as a solution to the demands for increasingly complex curricula, high retention rates and equitable provision, all within tight budgets. The State of Victoria in Australia, is at the forefront of these initiatives. There is little research on ITV in schooling, especially as a means of developing and sustaining forms of interactive learning. This paper discusses some of the arguments concerning interaction and dialogue that are important to understanding the use of ITV in schooling.

Introduction

ITV has been introduced in schools of many countries as a solution to the demands for increasingly complex curricula, high retention rates and equitable provision, all within tight budgets. Australia, especially Victoria, is at the forefront of these initiatives however there has been little research on ITV, especially as a means of developing and sustaining forms of interaction which foster learning. Interaction is constituted as the capacity for the students to engage in contiguous or non-contiguous means of communication with other people in order to facilitate their learning.

The use of satellite, cable and, increasingly, digitised forms of ITV broadcasting and 'narrowcasting' to schools[1] has become an important feature of schooling in countries, such as Australia. In such countries, geography, demography and/or climate make it difficult to provide efficient 'traditional' schooling across the range of curricula required of schools from primary through to secondary levels. Canada and Scandinavia are two international examples where ITV is becoming increasingly significant in schooling (Haughey & Roberts, 1996; Meisalo, 1996). In Australia, Victoria has developed what is arguably the most widespread system-wide ITV provision of any similar school system in the world. The Victorian provision has spread to other states in Australia, and there are also other examples of smaller ITV networks (for example, in Western Australia and Queensland) in operation.

Whilst, until early this decade, broadcast television played a small, but important, part in schooling through the Australian Broadcasting Commission provision, the current emphasis is on school authorities using new means of television transmission to fulfil their mandate to provide schooling for all people of school age. However, unlike TV broadcasts, the emphasis in these new school-based providers has been on building *interactivity* into their provision; the sorts of interactivity which teachers and students expect of schooling, but not of television. Schooling, especially primary schooling, is one of the most interactive educational contexts and students are expected to engage in dialogue in order to learn; teachers find it difficult to imagine teaching otherwise. Given that much of the curriculum development in ITV has been in languages other than English, it is no wonder that the construction of ITV into a means of facilitating dialogue within the classroom, and within the broader ITV community (with other schools, the program makers and presenters, etc) has been seen as a priority. However, there has been a struggle to understand the practical construction of such forms of dialogue within the ITV community (Barty, 1996). This project provides research upon which policy, practice and theory can be built which addresses ITV in schooling

Educational Dialogue

The potential of ITV to be a more 'industrialised' and also highly centralised form of 'distance' schooling sits uneasily both with student-centred approaches to learning and also with teachers' (and teacher unions' and subject associations') concerns for professional autonomy. However, educational technologies, such

[1] We are focussing on schools and the use of ITV with children in this research. ITV has other, somewhat different, uses in other education and training sectors.

as ITV, can be used in ways which encourage dialogue and participatory forms of learning, if the programs are designed to foster such and if the local teachers and learners work accordingly.

The 'dialogic approach' is not yet a dominant paradigm in research, theory and practice in distance education, educational technology and open learning but it is becoming very influential (Buckley, 1992: 81-84; Lockwood, 1992: 41-49; Morgan, 1990; Paul, 1990: 88-90). As part of this approach, educational technology has joined dialogue as a central concept within a framework which views teaching practices as mediated processes relevant to their social and historical circumstances. 'Educational technologies are not simply the tools of educators—although this is a popular misconception, rather they are the knowledge, values and practices which constitute the development and use of those tools' (Evans & Nation, 1993b: 198-199). The interactivity of ITV suggests some useful lines of inquiry and analysis in terms of the local adoption and adaptation of the programs to local conditions, and even the reflection of local issues and concerns, through interactivity, into the global broadcast.

The School Contexts of ITV

The Victorian ITV network includes interstate provision, which is leading to a broader national significance, not only for ITV itself, but also for the proposed research project. The international significance of the ITV initiative is that the Victorian network is held to be the most comprehensive state education, system-wide, ITV network in the world. There are many examples of interactive television in educational contexts (Bruning, et al 1993; Zhang & Fulford, 1994), however, the use of ITV in schools is relatively unusual (there are instances, in Canada and Scandinavia, for example Catchpole, 1993). Typically, school and other educational sector uses of interactive television are based on dual or multi-site 'video-conferencing'. Broadcast uses are generally not interactive, (such as the Open Learning Australia broadcasts in Australia, or those of the Open University in the UK, or the Open Learning Institute in Hong Kong). It is in this context that a study of the use of ITV in Victoria is internationally significant, especially in terms of the potential benefits of the findings for future government policy and for educators and scholars, both in Australia and overseas.

The potential impact of ITV is significant for schools. Although current evidence suggests that usage in schools is generally patchy, the pressures on schools to provide a wide and varied curriculum, and the predicted decline in the numbers of teachers—particularly in specialist areas such as languages other than English—points to ITV, and other communications and computer technologies, adopting a higher profile. In Victoria, these trends are already in evidence, and ITV usage is increasing steadily. Interstate usage is less clear, but it is understood that ITV is developing similarly, but is less widespread (Mark, 1995). Evans and Nation (1993b) found that the ways educational organisations initiate and foster change is a complex social process which is replete with conflicts and contests. Such conflicts and contests spring from the different values and interests of the parties concerned. Other work by the researchers (eg. Evans & Newell, 1993; Evans & Tregenza, 1993; Stacey, 1995) points to the importance of systematic support and appropriate resourcing in order to facilitate change. In this case, it is hypothesised that Victorian schools are likely to reflect more widespread and effective use of ITV, than interstate schools, due to the weaker support and resourcing provided.

Exploring these processes of change surrounding ITV within the context of different schools, as well as including a consideration of the central players in the government departments, is achieved using qualitative research approaches in a case-study form. Such approaches are particularly important where the focus is on the interactive elements of the teaching and learning process as it is mediated and shaped by ITV. We are more and more in a position where ITV and other communications and computer technologies (which share many common features with respect to the issue of shaping and mediating interaction and dialogue) could become substantial media for reshaping the ways schooling is managed and practised. However, this will only occur to the extent that ITV actively engages the lives of teachers and children, and through such change the practices, management and culture of schools. To achieve this end in ways which are worthwhile for teachers, students and schools, it is necessary to understand the practices and processes of such facilitated and mediated interaction which ITV provides.

ITV and Children as Learners

A significant aspect of this research focuses on the children as learners through ITV. Current literature, inspired by Vygotskian theory, which researches the significance to learning of social interaction and discussion, has provided a framework for observing the role and impact of technology as a mediator in this interactive dialogue (Stacey, 1997). Through observations and interviews, the research provides findings concerning the ways in which children interact with ITV and interact within the classroom with their teachers and peers as a result of the strategies deployed through ITV. This will be particularly focussed on analysing the learning outcomes achieved though ITV as identified and described by both the teachers and students. An important element of the research will be to assess these outcomes against the students' relative ability-levels in their ITV program subject area as compared with their teachers' expectations and other similar students' performances who do not use ITV. This will make a very significant contribution to our understanding of the effectiveness of ITV, in terms of both particular subject areas, and also for particular age and ability levels.

Given the range of evidence and experience on the gendered nature of schooling in general, it is important that gender is considered in relation to the use of ITV, especially in terms of boys' and girls' interactions and experiences. In these respects the research extends Evans's previous work in terms of the gendered nature of schooling (1982, 1987a, 1987b, 1988) and relates to the work which identifies the gendered nature of technology in society more generally (for example, Wajcman, 1991). Therefore, the research design ensures appropriate representation of gender issues, in addition to particular observations of the gendered life of the ITV case-studies.

The Case-studies

The research uses qualitative research methods founded within educational ethnography including case-studies, interviews, observation and document collection to develop case studies of the implementation and use of ITV in the selected schools. Qualitative methods best allow us to explore the processes of change surrounding ITV within the context of different schools. Interviews are conducted with relevant teaching staff, students and Department of Education personnel.

This project explores the extent, nature and problematics of educational dialogue through interactive television (ITV) in primary and secondary schools. In particular it is designed to:

- investigate, record and analyse, the use of ITV in primary and secondary schools, especially in terms of the development of interactive and dialogic approaches to teaching and learning.
- study the processes through which teachers and students adopt, and adapt to, the interactive and dialogic elements of ITV.
- analyse the findings in terms of the changing nature and demands on schools, and to relate these to issues of the social and cultural conditions of schooling, including gender, rurality and ethnicity.
- analyse the findings in terms of educational theories and practices of dialogue, and especially to those concerning mediated forms of educational dialogue, such as in open and distance education theory and practice.

Research Plan

The first phase of the research in 1998 involved the selection of five primary schools each being from either a country, regional or metropolitan region. Two of the selected schools are non-government schools. In each primary school ITV case-studies have been conducted simultaneously each being split between the main curriculum areas of ITV (Science and Technology, and Languages other than English). Throughout the year teachers have been invited to discuss the children's learning with ITV, as well as their own experiences of teaching with and alongside ITV. Typically, the ITV broadcasts are only part of the timetable for the particular curriculum area and the teachers work with the children 'off-air' in other timetabled sessions. These lessons are also observed in addition to the actual ITV broadcast sessions which may be either watched live by the class, or taped and played back at another time.

The second phase of the research to be conducted in 1999 will involve the nomination of three secondary schools where six case-studies will be developed. The curriculum areas selected for study at these schools will be chosen from those used via ITV. In addition to the specific focus on the case-studies, a sample has been made of other uses of ITV in the schools and by the Department of Education.

A phase of the research includes the development of six mini case-studies across New South Wales and South Australia for the purposes of comparison and contextualisation. This involved one day visits to one primary school in each state during 1998; and two secondary schools in each state during 1999. These mini case-studies involve visits by a project team member for the purpose of observing ITV sessions in progress and subsequent follow-up lessons, and to interview staff and students about their experiences with, and use of, ITV.

ITV Programs

The Victorian Department of Education regularly transmits a number of programs to schools through the satellite learning network, the main curriculum areas being Science and Technology Education in Primary Schools (STEPS) and Primary Access to Languages via Satellite (PALS). Other 'special' programs are also broadcast throughout the year. In 1997, 600 hours of programs were broadcast, 2,500 schools participated and an estimated 100,000 students learned another language via satellite.

STEPS consists of a series of programs that assist teachers in the delivery of science and technology education within the framework of the Victorian Curriculum Standards Framework. Students are able to participate in each program as it is broadcast live to air. This provides opportunities for the students to interact with the teacher (presenter) in the studio. Each school participating in STEPS is provided with comprehensive classroom support materials comprising a list of resources required for each program, the expected student outcomes, a brief summary of the program format and detailed descriptions of the activities to be undertaken. The programs, either thirty minutes or one hour duration depending on the year level, are broadcast fortnightly catering for the Prep; 1/2; 3/4 and 5/6 year levels. Schools are required to complete work and activities to prepare for the broadcast and also post broadcast. STEPS also integrates the use of multiple media through their World Wide Web site which provides general information, a teacher discussion page and a student discussion page. This Web site complements and enhances the programs rather than just duplicating the printed materials and the transmissions.

To facilitate the teaching of another language, PALS programs are broadcast to primary schools twice a week covering languages including Italian, Indonesian, Mandarin, Japanese, French and German. A similar concept has been developed for the teaching of another language at the secondary school level called SALS (Secondary Access to Languages via Satellite). As with the STEPS programs, teachers are provided with comprehensive classroom materials that support and complement the language programs. These programs run for thirty minutes and encourage students to interact live with the studio presenters. Students are required to complete pre and post broadcast activities to facilitate their learning.

One example of a 'special' ITV broadcast is *Communicating over the catchment*. This is a student conference concerned with conservation of the environment. Each year it is developed and broadcast live from Melbourne Zoo with support from the Murray Darling Basin Commission. The annual satellite broadcast consists of two, one hour long programs about conservation issues, and provides students with the opportunity to interact live with zoo experts via telephone, fax, email or a special Web Chat facility. The broadcast is only one aspect of the interactive program. There are also preliminary activities through interactive communication through a Web site, and also through use of a student resource kit and professional development support materials for teachers.

Preliminary Findings

The observational data from the first year of the study has begun to provide a range of emerging themes. Teachers' strategies and planning are integral to the best use of the ITV programs and several important factors are beginning to appear in the results of the study.

Interactivity

As predicted in establishing the study, the interactive element of the ITV programs is an important component of the use of this technology and it is established in a number of ways. These ways of interacting with the program are varied and the programs are designed to include the children in activities before and during the broadcast so that they are not always passively receiving the broadcast but are regularly given the opportunity during the program, to participate in teacher managed interactive discussion within the classroom.

These interactive points can also be part of the broadcast if the classroom teacher sets up the process and representative groups of children in the classrooms observed have had opportunities to interact with the program presenters through telephone links during the live transmission of the program or more rarely, as participants in the studio production and broadcast. These are heard and seen over the broadcast and are a very motivating aspect of the children's learning by this medium. All the participating students have been excited to hear their school acknowledged and this motivational factor, as much as the opportunity to answer a question, or report on an activity has kept the classes focused on and interested in the programs. The students also respond to these interactive points with interest when children from other schools appear, so the peer interaction appears to be an important factor in the success of the programs.

Schools also send work into the program producers which is also acknowledged and read out during the broadcast and this again provides students with an motivational involvement in the program.

Some schools tape the programs and then can stop the program and interact through teacher managed activities and discussion allowing more time and repetition. This has been observed to be a useful repetitive interaction particularly with the language programs (PALS) where sometimes the speed of the new vocabulary use and the difficulty in comprehending the language used in the broadcast requires help and translation to be effective.

Management

The different ways schools use the programs, alluded to above, seems to make a difference to the effectiveness of the programs for learning. If preparatory classes are held and the content of the program is integrated across the curriculum of the class, there is more interest and involvement from the children during the broadcast. In one classroom observation, the familiarity of the children with the Indonesian song and their physical placement with their notes with the song's words easily accessible, meant they could all participate in singing together during the program. However at another site, the children did not attempt to participate as they were less practised with singing the songs and had no easy access to the words, making the broadcast less interactive for them.

The flexibility of the whole school's approach to the technology use impacts on this aspect of the program's effectiveness as well. If an ITV program cannot be scheduled easily into a busy school program or there is inflexibility in the manner and timing of the school's broadcast of the program, classroom teachers cannot always vary the live and taped broadcasts to suit the children's learning, and cannot customise the progams to their students' learning as effectively.

The teachers' use of the program notes in their curriculum planning depends on them receiving this information in sufficient time. This management issue was one that has been frequently mentioned by teachers as an important factor if the broadcast team's planning cycle does not concur with the planning timeline of the classroom teachers.

Media Integration

Greater integration of the ITV media with electronic communication is a emerging factor of importance as the Victorian schools become networked and provided with an easier access to electronic communication. The schools who watch the STEPS programs and access the Internet most confidently are able to use a wider range of multimedia activities provided through the STEPS World Wide Web site (http://www.sofweb.vic.edu.au/steps/) and through emailed activities devised by the STEPS production team.

As Victorian schools are all included on a new VIC One network by the end of 1998, this aspect will begin to be available to all participating schools and will provide a new communicative aspect to ITV use.

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World Wide Web Sites

SOFNet: http://www.sofweb.vic.edu.au/sofnet/
STEPS: http://www.sofweb.vic.edu.au/steps/
Communicating over the catchment: http://www.coc.zoo.org.au/studcon.html

Combining User-Centered design and Activity concepts for developing computer-mediated collaborative learning environments: a Case Example

M. Felisa Verdejo

Beatriz Barros

Departamento de Ingenieria Electrica, Electronica y Control,
Escuela Técnica Superior de Ingenieros Industriales (U.N.E.D)
Ciudad Universitaria s/n, 28040 Madrid, Spain
{felisa, bbarros}@ieec.uned.es
phone: 34 - 1 - 398 64 84; fax: 34- 1 - 398 60 28

Abstract: Formative evaluation and iterative prototyping seem an interesting approach for building collaborative learning systems. Our approach to create our software system consisted on iterating successive stages of analysis, specification, implementation and evaluation. At the end, the process turned out to be a five-pass cycle, carried out in two years, with a major reimplementation between the third and the fourth prototype version. We describe the main features for each version, as well as the evaluation techniques followed. The first cycle is presented in more detail and relevant aspects are summarized for the rest. Each evaluation includes the design of a learning activity, the configuration of the prototype to carry out the experience, the set-up and observation of the activity performed with real students and tutors, and finally the drawing of conclusions including the improvements to consider for a next design phase.

Introduction

For a number of years we have been involved on research and experimentation with collaborative learning at a distance in an effort to identify and deploy appropriate uses of the new media to support a distance learning community. In this paper we focus on the process of designing a software environment to support collaborative learning activities in an integrated way. The design of collaborative software has proved to be hard. Theories and metaphors in the CSCW field have emerged but are still a matter of big debate and further elaboration is needed to produce models supporting the practical design of CSCW applications. The difficulty comes from the complexity of the situations to be considered, where the technical perspective is one part of the picture. In a specific work situation, technology should support human activity taking into account the social setting: an organization with rules, structure and working practices.

Formative evaluation and iterative prototyping seem to be an interesting approach for building collaborative learning systems. Conducting experiments to find out how the prototype is used and what is learned from its use provide insights, not only into how to improve the system but also into how to motivate further extensions. A conceptual framework is still needed to analyze and capture how the technical solutions in each version of your prototype will support the group of learners to attain their goals. The socio-cultural framework provides the concept of Activity (Nardi, 1996) as a unit of analysis, with a rich internal structure to make the context of a situation explicit, specially the interlinks between the individual and social levels stressing the role of the tools as mediating artifacts.

One of our systems serves here as a case study to illustrate the potential of combining user-centered approach (Gould & Lewis, 1985) with Activity Theory to design collaborative learning software. The next section describes our context, and elaborates on the kind of learning tasks and collaborative framework we have considered. In section three the main features of the iterative design are presented and learners' experiences discussed. For a detailed description of the system itself the reader can consult (Barros & Verdejo, 1998).

Context, goal, and premises for defining the learning approach

Collaborative learning research has paid close attention to studying pupils interactions during peer-based work in order to analyze and identify the cognitive advantages of joint activity. As Crook (1994) points out the benefit of the collaborative approach for learning lies on the processes of articulation, conflict and co-construction of ideas occurring when working closely with a peer. Participants in a problem-solving situation have to make their ideas explicit (assertions, hypothesis, denials..) to other collaborators. Disagreements prompt justifications and negotiations, helping students to converge to a common object of shared understanding.

The computer provides opportunities to support and enhance this approach in a number of ways (e.g. offering computer-based problem spaces for jointly create and exploit structures of common knowledge and shared reference). Furthermore networks made possible the opening of collaborative frameworks to distributed communities, providing remote access to these spaces as well as computer-mediated communication to support interpersonal exchange and debate. An increasing number of collaborative learning environments for open and closed virtual groups have been built for a range of learning tasks (Scardamalia & Bereiter, 1991) (Edelson & O'Neill, 1994) (Wang & Johnson, 1994) (Suthers & Jones,1997), and experiences of use are reported from school to university level (Bell, Davis & Linn, 1995) (Collis, 1997).

The potential of collaborative learning, within the framework of a distance learning institution, has to be explored taking into account the traditional practice of individual and stand-alone study in distance education. Not only faculty but also students are reluctant to carry out collaborative practice. Network facilities are widely appreciated as a way to improve the efficiency of how course material is delivered rather than an opportunity to change patterns of teaching and learning. So the challenge for developing collaborative activities in a traditional distance learning university is not only to build appropriate tools but also to transform established practices in the community. For these reasons, it is quite critical to look for opportunities of implementing collaborative learning experiences where collaboration could be perceived by students as a clear added-value to existing learning practices.

So we want to propose that our distance learners, geographically distributed, work together in small groups to prepare an overview of a topic related to their professional profile. There are a number of ways in which this collaborative activity can be organized, one of the procedures that we have implemented consists of a phase of joint involvement in the preparation of the work within each group, followed by a period of individual reading. Then participants engage in a dialogue to elaborate collaboratively a synthesis according to a schema. Variants can include a phase of planning and the negotiation of the schema before to the collaborative writing. A further step could be mutual presentation of the final products between groups.

From the learning point of view the task fulfills the requirements of been relevant (it corresponds to a real practice in a research context) and co- constructive in the sense that they have to build their own shared understanding of the topic. Furthermore the discursive nature of the procedure and the deferred mode for the debate afford opportunities for the students to reflect on the way they perform the collaboration process.

The iterative design process

Our approach to create the software system consisted of iterating successive stages of analysis, specification, implementation and evaluation. At the end, the process turned out to be a five-pass cycle, carried out over two years, with a major reimplementation between the third and the fourth prototype version. Next we will describe the main features for each version, as well as the evaluation techniques followed. The first cycle is presented in more detail and relevant aspects are summarized for the rest. Each evaluation includes the design of a learning activity, the configuration of the prototype to carry out the experience, the set-up and observation of the activity performed with real students and tutors, and finally the drawing of conclusions including the improvements to consider for a next design phase.

The first cycle. *The prototype*

The first prototype, installed on a web server, offered the same services to all clients. The access was remote and the mode asynchronous. Each user had a login and a password and belonged to a group. The system supported a number of small groups operating at the same period of time.

The main metaphor in the prototype for sustaining a learning activity is the concept of *space*, a virtual structured place with resources and tools to perform a task. Three types of spaces were available: an individual workspace, private for each user, and two shared spaces for each group (one workspace for debate and joint construction, the other for coordination purposes). The information handled is mainly textual, so a variety of editing tools and file management facilities was available, as well as links to other relevant electronic sources of further information for the task at hand. The shared workspace provided support for conversation in the form of semi- structured typed messages. When learners express their contributions they have to select a type from a predefined set. These types include: proposal, contraproposal, comment, question, and clarification. The system dynamically builds a representation of the discussion process going on in each workspace, in the form of an index of related contributions for each subtask. This index was fully deployed and represented on the left part of the workspace screen.

The evaluation phase

The first evaluation addressed the central point of the adequacy of the shared workspace to support a group of learners to perform a discursive task. The design of the learning activities was carried out by our team, as well as researchers we are also teachers. Two kind of learning situations were considered. We describe one of them, characterized in terms of Activity Theory (Kuuti, 1996) (Cole & Engestörm, 1993) as follows:

The object of the learning activity was to synthesize the state of the art in a focused research topic. Two topics were selected: one in Artificial Intelligence (AI), the other on Educational Technology. *The outcome* of the activity was an essay, pointing out the key ideas. The schema for the essay was previously defined by the tutor, and included in the shared workspace. *The community* involved in the activity were pairs of graduate students in a Ph.D. distance teaching programme, in UNED, our university. Students were part time, geographically distributed, usually interacting in disjoint time slots. *The subject*, each individual student, had either a technical or non technical profile, but groups were formed by people with the same background. The topic for the groups with technical profile was in AI

Mediational tools included: (i) humans, a tutor and a technical assistant both from our team (ii) artifacts: the phone, a set of documents and (iii) the prototype: a networked computer environment including the script of the activity, private and shared structured task spaces for peer argumentative discussion, coedition and coordination, as well as access to other electronically available sources of information. *Rules* for the activity were stated explicitly and have to be accepted before starting. They include the commitment to finish the work, the script for the activity and the protocol for the collaborative debate. Some of these rules were embedded in the system, for example, the conversational graph defined the way one can contribute after another peer contribution. Others were the full responsibility of the learners, such as the way to organize the discussion, the way to agree, as well as aspects of time management and deadlines. The only direction given was to use the coordination space to deal with all these matters, using the coedition workspace only for the topic discussion. Students in each group had the same responsibility. The task is divided in subtasks but there were no predefined roles for *division of labour*.

Performing the activity

Once the learning activity was designed and the prototype ready, the experience went to a set-up phase to organize the formation of groups, fix the training strategy for the use of the tool, prepare the support strategy and establish the evaluation framework. In this case students were recruited on a call for volunteers. The groups were made up by the tutor. A handout for the use of the system was distributed to all participants, and a session of practice on their own was recommended before starting the activity to became familiar with the tool. Moreover an interactive training session, using the phone and the system, was offered and carried out with one of the students. Technical support for the whole period of the experience was provided, a person could be reached either electronically or by phone to deal with questions or problems related to technological aspects.

For content or pedagogical related matters, a teacher was also available. Along the running stage of the experience her role was to act only on request, however for evaluation purposes she was observing actively the use of the system. Events and data were all recorded. This information together with teacher and assistant notes, as well as individual interviews for dropping-out cases, were the main sources for the assessment of the prototype.

Results

Three groups started the activity and only one arrived at a completion state. All the groups performed the preparatory phase, but one of the groups dropped-out early, before engaging in the collaborative step, another student dropped-out in the middle and we had to redefine the learning task for the remaining student to allow him to continue alone. Finally the third group worked well and accomplished the whole activity, having a balanced participation.

This 50% ratio of drop-out is comparable to a standard course. In the first group both students changed their job and were not interested anymore in the course. Some students needed help and technical assistance for the communication infrastructure, being the first time they had connected and used Internet. The system was considered easy to use, and students in the third group stated the experience as successful, appreciating the benefits of collaboration, despite the additional constraints this form of work demanded on them. Added-value was perceived in three dimensions: more depth in content related matters, becoming familiar with new technologies, and improving collaboration abilities.

The concept of structured shared workspace proved suitable for the learning task, however, as expected, significant problems were pointed out: some regarding either the interface, the functionality of the prototype, or the accessibility and reliability of the server; others to group related aspects of engagement, participation or tutor intervention. Related to the interface, the representation of the discussion as an index fully deployed on the left part was uncomfortable to handle when it became long. Some problems of consistency with buttons for editing operations were also detected. Related to the collaborative task, students missed the explicit agreement option. This was considered to be a natural way to conclude a discussion. An important issue was the lack of a separate representation for the process and the outcome. The possibility to look for what was being achieved -drafts of the essay- at different stages of the process, separated from the discussion was perceived as useful.

The coordination space, a public list of messages, suffered from lack of privacy. Students wanted to send messages not only to groups but also to individuals, particularly the tutor or the assistant. Facilities for browsing and reading related messages with different criteria, for instance topic, date, etc., were not provided. The period of the experiences lasted for the '97 spring term.

A second experience using the same prototype was carried out, involving three groups of students in a master program of another, non distance, university. In this case students combined face to face teaching sessions with collaborative discussions through the system. Groups consisted of three students who knew each other previously. The patterns and style of the interactions were clearly different and specific problems of mutual awareness and concurrence arose due to a more synchronous use of the system. Comments from students, feedback from tutors, and improvements suggested by designers were discussed in the analysis phase of the second version carried out during the summer, in order to have a prototype ready for the 97/98 autumn term.

The second and third cycle

The main redesign for the second version concerned the structure and function of the shared workspace. Instead of a unique workspace, three related subspaces were defined, one for the joint elaboration, a second one, the result space, to keep separately the outcome, and the third, the version space, to save the process and the outcome at different stages. The conversational graph included agreement as an option. Once all participants had performed this action for a particular proposal, the system automatically loaded the text on the corresponding subtask section of the result space. Thus, each subtask has to be finished by explicit consensus. The conversational graph, wired in the first version, was configurable from an external data file so that it could be different for different tasks. Moreover, the number of workspaces was an option to be defined at the configuration of the prototype, depending on the needs of the learning activity.

Related to the interface, these were the main new features:

- As the number of spaces increased, on the upper part of the screen, a button bar enabled the user to go directly either to the information space, the individual space, the shared workspaces or the coordination space.
- All the shared working spaces (version, result and elaboration) were directly accessible from each other, by buttons, and they have a similar interface.
- The representation of the discussion process on the left part of the elaboration workspace was redesigned in order to allow the folding and unfolding of the content index of the contributions for each subtask. This helped to reduce the amount of visible information, focusing on the task at hand.
- The interface was rewritten in English to allow a wider use.
- Messages in the coordination space could be one-to-one or one-to-many.

As in the first cycle, the evaluation phase consisted of steps for fixing the objectives of the evaluation, designing, setting-up and performing the learning experience. In this cycle we aimed at two different scenarios to test the versatility of the system regarding other communities and activities. The first one was to support the discussion of a group of international experts, distributed all over the world, previous to the celebration of a working conference. The second one involved a teacher and their graduate students, all external to the designer's team, using the system as a complementary activity. The learning activity was fully designed by the teacher. In both cases the prototype was configured by a member of the research team to generate an environment adapted to the activity, i.e., number of workspaces, its structures, associated conversational graphs, and links to other sources, as well as roles and participation rules. All these features were different in each experience.

Results

From users the main feedback in this cycle was the need of: (1) having notification when new things happened related to the group activity; (2) seeing at a glance where new things were placed.

From the monitoring of these and previous experiences, we also concluded:

In relation to collaborative aspects

- In the case of students, procrastination is a problem, support for explicit time management as well as negotiated intermediate deadlines should be considered.
- For full distance learners, a preliminary phase to set up the group, establishing common objectives and protocols is a must to ensure their engagement as well as to enforce their feeling of belonging to a group.
- In the case of larger, open groups, a well-specified purpose, shared responsibility and the role of a moderator are key factors to promote interaction and participation. The only existence of the mediational tool does not, of itself, generate patterns of collaboration.
- Teacher intervention along the collaborative process remains an open question: whether this should be supporting the group spontaneously or on request, being involved as a member of the discussions groups with

an specific facilitator role, or entering as commentator at specific time of the process. Students feelings were quite controversial on that point.

In relation to the system

- On-line help, guidelines for each activity, and rules of participation should be included in the system, in addition to handouts (i.e. the more integrated and self contained the system, the better its usability). For Spanish students, English for the interface was accepted, if all the rest was available in Spanish.
- Facilities, beyond notification, to handle, monitor and analyze the collaboration processes are required. Both during and after the experience.
- A configuration mode should be available to generate tailored web sites, as automatically as possible from the data provided by the designer of the learning activity.

The fourth and fifth cycle

At that point we decided to rethink the whole system architecture, characterizing levels and generic components and implementing the workspaces on a database framework. For further details on this point see (Barros & Verdejo, 1998). Besides the full reprogramming, the improvements for the next version concerned two aspects:

- The definition of roles for shared workspaces allowing to distribute responsibilities for a learning activity. For each role a profile of features was defined, where accesses and privileges for different uses of the system could be configured. A simple mechanism of notification was also introduced and could be enabled or disabled in the role profile.
- The redesign of the coordination space to provide not only an enhanced e-mail facility including a variety of filters to browse the messages with different criteria, but a new tool, a group agenda to facilitate time management matters.

Evaluation Phase

The evaluation followed the same steps as in the previous cycles. This time the new issue addressed was to test how easy the system could be adapted by the users themselves, for instance, allowing learners to configure workspaces completely tailored to their needs. This possibility opened the range of learning activities that the system could support. For instance, students performing design tasks or negotiating among themselves their collaboration schemas. So we planned and executed an experience where the learners, using the system, could also participate and decide aspects of the learning activity they have to perform in collaboration, such as the conversational graph structure for the elaboration process, roles and their distribution, or the schema for the outcome. We launched an experience comprising three learning activities. The first one, a collaborative synthesis on an Educational Technology topic. The second one, the selection and definition of a case study; and the third the elaboration of a detailed proposal for the case study. A teacher, a technical assistant and two groups of three part-time students following a Ph.D. course worked together for 6 months.

- The objectives for the first activity included acquiring knowledge of a selected topic, and developing collaborative abilities as well as becoming familiar with the use of the system.
- The second activity was a preparation for the third one, students had to attain three goals: (1) to select, discuss and agree on a case study, i.e. a learning activity, (2) to write a detailed plan to develop their proposal including the structure of the outcome, and (3) to fix the responsibilities of each one on completing this proposal.
- The third learning activity included the configuration of the shared workspaces where they could develop the design of their case study.

They started to work with the third prototype. This time as the experience lasted for a longer period as soon as some problems were detected we decided to work simultaneously on the system, so that they started with version 3 but finished with version 4. New features were included. For instance the initial bar included all the activities and there was the possibility to state temporal restrictions between activities so that spaces were accessible only when the time conditions were fulfilled. Agreement methods were extended and could be selected between consensus or majority. Further tools were also provided for global and individual evaluation: the representation of accesses per hour, work evolution in the experience period and number of contribution type. For global analysis there were an option for visualizing the evolution of the discussion by access and by user and the evolution of work by section and user. These results could be visualized in graphics or textual form. Also a tool to create, fill, submit and, automatically process WWW-forms was provided in order to systematically collect student feedback.

Version four

A major extension in version 4 was the concept of an organizational learning memory. This was a structured repository of collaborative learning activities containing selected events and outcomes (Barros & Verdejo, 1998). This memory was defined and implemented with a range of editing and searching facilities. Initially we filled it with relevant data collected in previous evaluation cycles. This resource can be exploited for a variety of educational purposes, two of them, scaffolding and peer evaluation, were tested on the latest cycle developed during the last three months of the 97/98 academic year.

Two experiments were carried out. The first comprised two learning activities. One was fully defined by the teacher, the other only partially predefined. The learners once the first activity was completed had to select outcomes of cases stored in the organizational memory to perform a peer review. The second experiment followed a similar approach but this time students could use previous cases as guidelines for their own work and not only for the peer evaluation step.

Results

- The experiences in this cycle, as well as the system, were more complex. Close monitoring from the teacher became critical, but also a clear state of affairs was very helpful for students. Notifications provided automatically from the system to learners and the teacher about selected events improved the "what is going on" with respect to the other versions, but the solution to present the "what is new" required some further analysis. In short this information has to be presented not only in quantitative terms but also in a more qualitative flavor.
- There were also problems with the generation of tailored versions of workspaces. The configuration procedure demanded additional understanding of the system, and the students were not prepared to invest time on that point. They preferred to specify what they wanted and have the technical assistant doing it for them. This suggested that more training on the tool and better configuration facilities are needed.

These two points were addressed on the next, current version, of the prototype. The current architecture of the prototype is organized in levels: configuration level, performance level, reuse level and reflection level. We consider the tool robust and versatile enough to finish the development phase and to proceed to a wider dissemination in order to prepare a summative evaluation phase.

Concluding remarks and further work

Formative evaluation has been essential to guide the team in tuning the tool and for suggesting directions for further extensions. Prototype testing with real users helps not only to reach technical validity but more importantly, to face the complexity of implementing collaborative learning. Social and institutional factors are essential when designing collaborative learning activities, specially in a conventional educational framework. In this sense Activity Theory seems a promising framework for modeling learning situations with a global approach. Issues for the next evaluation are, on the one hand, to look more closely at pedagogical and collaborative effectiveness, and on the other to collect more experiences. We perceive that practical guidelines for designing and performing these activities, not only looking at learning objectives but also dealing with social and organizational issues, are indeed needed.

Acknowledgments

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A Learning Assistance Method for An Intelligent Physics Learning Environment on Force Recognition

Mikiko Fujimoto, Tsukasa Hirashima and Akira Takeuchi
Artificial Intelligence
Kyushu Institute of Technology
Iizuka, Japan
{mikiko, tsukasa, takeuchi}@minnie.ai.kyutech.ac.jp

Abstract: This paper proposes a method of learning assistance for a physics learning environment. The learning objective of the environment is to acquire ability of recognizing forces acting on physical objects. Because the knowledge of applying fundamental concept and rules, such as the concept of gravity and Newton' law, is empirical knowledge, learners need training to acquire the ability. We propose a method of triggering off reflection by comparing two physical systems. Our method generates a physical system depending on the cause of a learner's error. By comparing the generated system and the originally given system, the learner gets some clues to recognize forces acting in the original system, or some clues to recognize inconsistency of the learner's solution.

1. Introduction

One of important features of intelligent tutoring systems is to provide assistance that is tailored for each individual learner. There are different teaching strategies, among which is to make learners reflect on their processes of working out solutions in order to acquire correct knowledge when they make some mistakes. Because assistance should provide information that leads the learner to aware inconsistency about the solution, it must be prepared depending on the causes of the learner's errors.

This paper proposes a method of providing feedback for a physics learning environment (Takeuchi & Otsuki 1997). The learning objective of the environment is to acquire ability of recognizing forces acting on physical objects. Learners have to apply fundamental concept and rules, such as the concept of gravity and Newton' law, on a given physical system in order to recognize forces. Because the knowledge of applying fundamental concept and rules is empirical knowledge (Anzai 1986), they need training to acquire the ability. The assistance of promoting reflection is, therefore, effective to activate thinking. We propose a method of triggering off reflection by comparing two physical systems. Our method generates a physical system depending on the cause of a learner's error. By comparing the generated system and the originally given system, the learner gets some clues to recognize forces acting in the original system, or some clues to recognize inconsistency of the learner's solution. Section 2 describes the overview of the learning environment, and the method of triggering off reflection by comparison is given in section 3. Examples of assistance are given in section 4. Section 5 describes evaluation.

2. Learning Environment for Physical System

Fig. 1 shows the structure of the learning environment for physical system modeling. Learners try to apply physical rules on a given physical system to recognize forces, and illustrate forces in order to express their understanding on the graphical user interface. Fig. 2 shows a snapshot of the user interface. When they want to study specific physical systems, they are allowed to construct arbitrary physical systems. Tab. 1 shows available physical elements. The causal relation model deriver in Fig. 1 creates the causal relation model from a given physical system. The causal relation model represents relationship among forces and elements. The student's kinetic model deriver creates the student's kinetic model from learner's illustration of forces. The student's kinetic model represents learner's understanding of the given system. The student's kinetic model has the same structure as the causal relation model. These two models are used as the source of diagnosis.

FIGURE NOT AVAILABLE

Figure 1: Overview of the Learning Environment

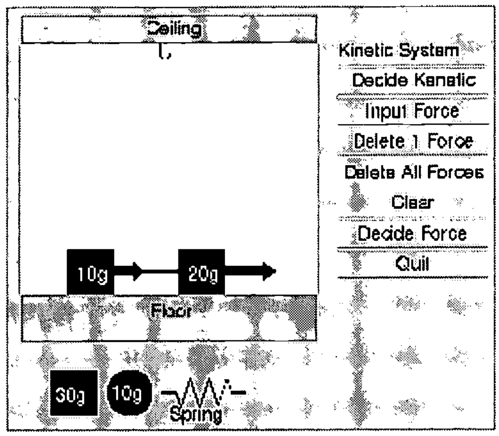

Figure 2: Snapshot of the User Interface

Table 1: Available Physical Elements

Class	Kind of Element
Finite mass	Block, Ball
Zero mass	Spring, String
Infinite mass	Ceiling, Wall, Horizontal plane, Slope

The learning support part detects learner's errors by comparing the student's kinetic model with the causal relation model. There are three kinds of erroneous phenomena about forces; missing (learners cannot recognize existing forces), extra (learners recognize non-existing forces), and error (learners make some mistakes on attributes of forces). The learning support part decides a method of assistance according to causes of learner's errors. This paper focuses on one of the assistance method; "presentation of a system for comparison".

3. Presentation of a Physical System for Comparison

We propose "presentation of a system for comparison" as one of assistance methods for learner's errors. Physical systems for comparison are generated by transforming the original system based on some rules. Purposes of the assistance are both helping learners to recognize forces acting in the original system easier and giving learners some clues to recognize errors and contradiction by thinking about similarity and difference between the original system and the generated system. Because the method of presenting systems for comparison is an indirect instruction and it doesn't communicate knowledge of physics directly, it is based on the assumption that learners have knowledge of fundamental physical rules but failed to apply these rules. This kind of errors often occurs about internal forces, i.e. tension and normal forces. The assistance method is, therefore, effective in cases of missing tension, errors of tension, missing normal forces and errors of normal forces.

3.1. Generation Process of Systems for Comparison

The generation process of systems for comparison consists of the following four steps.
1) To generate candidate systems by applying transformation rules to the original system. The transformation rules are described in section 3.2.
2) To derive the causal relation model for each generated system.
3) To check whether each generated system satisfies conditions of effectiveness as systems for comparison. The

Conditions are given in section 3.3.
4) To decide the order of priority, if more than one systems for comparison satisfy the conditions at 3rd step. Ordering rules are given in section 3.4.
Fig. 3 shows a generation process.

3.2. Rules for Automatic Generation

Candidate physical systems for comparison are generated by applying transformation rules to the original system. There are eight rules; deletion of a finite mass element, deletion of a external force, replacement of a finite mass element with an infinite mass element, replacement of a slope with a horizontal plane, deletion of a string, deletion of a spring, and replacement of an external force with an infinite mass element. In general, these rules are applicable repeatedly on an original system. However, we restrict the application time only once, because the resemblance between the original system and a generated system becomes low and it becomes difficult for learners to compare. These rules reduce complexity of the original system from the viewpoint of the number of physical parameters or the order of motion.

FIGURE NOT AVAILABLE

Figure 3: Generation Process of Systems for Comparison

3.3. Conditions of Systems for Comparison

Generated systems are effective as systems for comparison if they satisfy one of the following two conditions.
Cond.1) Learner's wrong interpretation of the original system holds in the generated system.
Cond.2) The same physical causalities about which the learner made an error exist in the generated system, and complexity of the generated system is lower than the original system. The complexity is measured by the number of physical objects and the order of motion.
Examples that satisfy the conditions are as follows.
Ex.1-1) The force that the learner has missed in the original system doesn't really act in the generated system. Or the extra force that the learner illustrated for the original system acts in the same way as the learner's illustration in the generated system.
Ex.1-2) The force that is equal with the learner's erroneous force acts in generated system. Correct forces that the learner illustrated for the original system also act in the generated system.
Effect of Ex.1-1 and Ex.1-2: The learner's interpretation of the original system holds in the generated system. Since forces actually acting in two systems are different and hence the motion of them are different, the learner will find inconsistency in his/her interpretation. Because the generated system is less complex than the original system, it is easier for the learner to understand generated system correctly .
Ex.2) The Learner missed a force in the original system and a force of the same kind as the missed force acts on the same element in the generated system and the element stands still.
Effect of Ex.2: Forces which act on the element balances in the generated system, because the element stands still. Because the generated system is less complex from the viewpoint of the order of motion, it is easier for the learner to recognize the missed force. Since the generated system preserves causalities between physical parameters, the learner will recognize the causalities of the original system.

3.4. Order of Priority of Systems for Comparison

In most cases, more than one candidate systems for comparison satisfy the conditions described in section 3.3. In order to select the most suitable system for comparison, the order of priority is decided according to the following criteria:
* It is easy for learners to find forces, if elements in a physical system stand still.
* It is easy for learners to compare two physical systems, if they are alike in appearance.
The order of priority is defined by both motion of elements in the system for comparison and the degree of

resemblance between the system for comparison and the original system. Tab. 2 gives items to be considered to decide the order of priority of the systems for comparison. As for a string, a spring, a finite mass element and an external force, the degree of resemblance is high when the score in Tab. 2 is high. As for motion, the score is high if a physical system stands still. The score of each physical system is calculated by summing up each item's score. The order of priority is decided by total score of each system.

Table 2: Check Item For Order of Priority

Check Item	***Score***
Motion	
All of finite mass elements stand still	2
At least one finite mass element stands still	1
All of finite mass elements don't stand still	0
External Force	
The force act in the same element of the original system	1
The force act in the different element of the original system	0
The force do not act	0
The force are replaced with an infinite mass element	0
Finite mass Element (for each finite mass element)	
The element exists in the system comparison	2
The element is replaced with an infinite mass element	1
The element is deleted	0
String, Spring	
String or Spring exists	1
String and Spring don't exist	0

4. Example

Fig. 4 shows an example of candidate systems for comparison generated from a given system. Eight candidate systems are generated by applying transformation rules. Here we assume that a learner made one of the following four mistakes.

1) missing tension of both ends of string.
2) missing tension of one end of string, and the value of tension of the other end is wrong.
3) missing tension of one end of string.
4) the value of tension of the string is wrong.

Tab. 3 shows the result of selecting appropriate systems for comparison. Numbers indicate appropriateness of eight candidates for the above errors. These numbers are the order of priority for each system, and the smallest

FIGURE NOT AVAILABLE

Figure 4: Generated Systems as Candidate for Comparative Systems

one is the most suitable system for comparison. Each number in the parenthesis is a total score of each system. Asterisks mean that candidate systems don't satisfy the conditions of the systems for comparison.

Table 3: Score (Our System)

Error	System1	System2	System3	System4	System5	System6	System7	System8
Missing tension-1	1(7)	6(3)	5(4)	*	3(6)	1(7)	3(6)	*
Missing tension-2	*	4(3)	*	3(4)	2(6)	1(7)	*	5(2)
Missing tension-3	*	3(4)	*	*	2(6)	1(7)	*	*
Tension error	*	*	*	2(4)	*	1(7)	*	*

5. Evaluation

We evaluated the result of generating systems for comparison. In order to investigate which physical systems are appropriate for comparison, we asked five university students to select effective systems for each error in Tab. 3 from eight candidate systems. Tab. 4 shows the result of the selection. Numbers indicate the percentage of university students who answered that learners would notice the error or contradiction by presenting the physical system when learners made the corresponding error.

Table 4: Score (University Students)(%)

Error	System1	System2	System3	System4	System5	System6	System7	System8
Missing tension-1	100	60	80	40	80	80	80	40
Missing tension-2	0	40	0	60	80	100	0	60
Missing tension-3	0	60	0	20	60	100	0	20
Tension error	0	0	0	40	40	80	0	0

By comparing Tab. 3 with Tab. 4, we confirmed that most of the physical systems selected by the learning system were judged to be effective for learner's errors by university students. And when the order of priority that our method decides is high, the percentage which they judged the physical system to be effective is high, too. From the above facts, we conclude that our method selects effective physical systems and the order of priority is proper.

6. Conclusion

We described a method of learning assistance that presents physical systems for comparison. From the result of evaluation, we confirmed that effective systems for comparison were chosen and the order of priority is proper.

Simulation based interactive learning environments are widely accepted in the domain of physics (Tiberghien & Mandl 1991). Simulation is useful to understand fundamental concept of physics by experiment and to grasp system behavior by observation. Stevens's innovative work (Stevens, Roberts & Stead 1983) combined a quantitative simulator with qualitative representation to emphasize causality. Qualitative simulation (Kuipers, 1986, Forbus & Falkenhainer, 1990) is also useful to explain causality explicitly and to help learners to understand causal relations of physical parameters. Both qualitative and quantitative simulations are based on equations of motion. Learning objectives of these methods are, therefore, to understand nature of constraints among system parameters. In contrast to these learning methods, we focused on acquiring ability of modeling physical systems or ability of deriving equations of motion, which provides justification of causality. The assistance method presented in this paper aims to activate learners' thinking.

Because similar cases or examples are effective for learning, some of intelligent tutoring systems have mechanism to manage similar cases. (Schult, 1993) proposed a similarity measure and (Reimann, 1993) proposed a method of solving problems by using a case-base in the domain of physics. Learners expand their knowledge by considering similarities. In contrast to these systems, our method uses similar physical systems to give learners clues to revise their errors. (Asami, Takeuchi & Otsuki, 1995) also proposed a method to generate physical systems that give learners to correct mistakes. Their viewpoint for remedy is the same as ours, but generation method and learning situation are different .

Though each module has been implemented, they have not been integrated into the learning environment at present. Validation of the method in real learning situation is future work.

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Instructional Design of WWW-Based Course-Support Environments: From Case to General Principles.

Sanne Dijkstra, Betty Collis, Deniz Eseryel
Faculty of Educational Science and Technology
University of Twente,
Postbus 217, 7500 AE Enschede, The Netherlands
E:mail: dijkstra@edte.utwente.nl,collis@edte.utwente.nl,eseryel@edte.utwente.nl

ABSTRACT: In this paper we describe the design of a WWW-based course-support environment for a course in instructional-design theories, give an overview of how the environment was used as part of the course experience, and summarize the student evaluation of the course. Our conclusion is that such a course-support environment can extend the teaching and learning process, if well designed, by bringing added opportunities for communication, coaching, and the increase of student self-responsibility. We do not see such a tool as replacing the instructor, but extending him or her. The design of the environment should reflect this. Although the article describes the particular case of a course about instructional design, we argue that the conclusions can be valid for courses of a variety of disciplines and instructional approaches.

Introduction

Despite the sophistication of many computer-related learning materials, we believe that sooner or later a teacher is required to motivate the students, to coach the students in the use of problem-solving methods, to explain the descriptions and interpretations of the subject matter, and to model the learning and practicing of skills. However, the typical classroom or course setting is not particularly conducive to stimluating communication with individual students in order to recognize their intellectual and motivational problems, to explain to them a difficult part of the subject matter, to provide clear tasks, and to coach the students' problem-solving activity. The often-repeated criticism of the whole-class approach has done little yet to change the system and increase personal contacts and coaching between the teacher and individual students.

We believe that the integration of computer technology with data communication, what is called in Europe telematics, creates new possibilities to support and amplify the communication between a teacher and the students and among the students themselves even in a large class; increases the opportunities for the instructor to coach on an individual basis; and provides the students a possibility to become more self-reliant in their approach to studying, while still retaining the benefits of the familiar face-to-face class setting and textbook. WWW-based environments in particular can combine the strengths of computer-based learning with those of instructor-guided learning and can help to overcome the mass-production aspects of the large course in higher education. But how does one design a WWW-based course-support environment to reflect this instructional philosophy? Are there instructional-design principles to follow? We address these questions via an example, a course about instructional design at the Faculty of Educational Science and Technology of the University of Twente in The Netherlands. The case we describe is just one of over 30 courses in our faculty that are taking advantage of WWW-based course-support environments to enrich teaching and learning, for students in the regular institutional setting as well as students sometimes or even primarily at a distance from that setting (see Tielemans & Collis, 1998).

A Description of the Course Instructional Design Theories

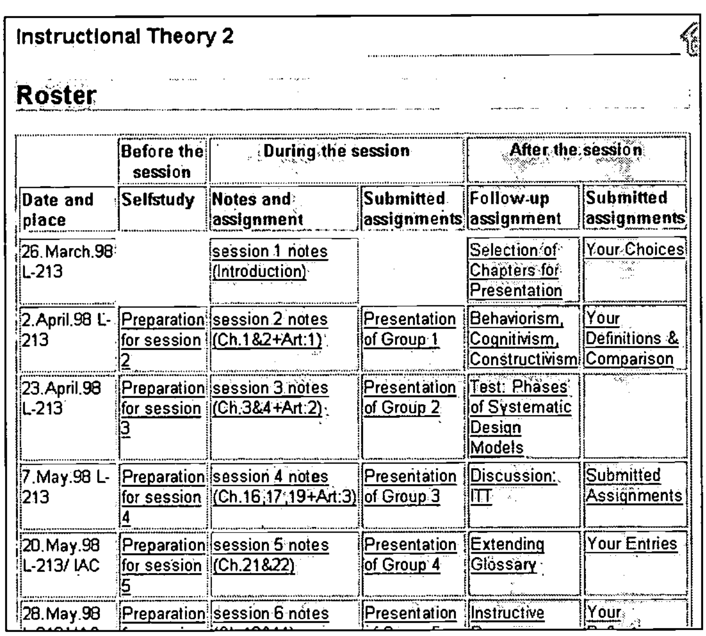
Instructional Design Theories is a 120-hour senior course in the Faculty of Educational Science and Technology at the University of Twente. Students in the course represent a mixed cohort, in terms of background relating to the theoretical principles relating to instructional design and of mother tongue. The language used in the course is English. The textbook used for the course is a scholarly analysis of the theoretical foundations of instructional design and of key research approaches (Tennyson, Schott, Seel, & Dijkstra, 1997). Moreover the meaning of the theories for solving instructional-design problems is shown (Dijkstra, Seel, Schott, & Tennyson, 1997). Because the students have different levels of prior knowledge coming into the course, their learning needs are different.

Design of the WWW-Based Course-Support Environment

Based on this, and also the key principles for all students of (a) supporting and amplifying the communication between the teacher and the students and among the students themselves, (b) increasing the opportunities for the instructor to coach students on an individual basis, and (c) providing the students the possibility to become more self-reliant in their approach to studying, the following requirements were established for a WWW environment to support the course:

- The site should provide access to prerequisite knowledge for those who need it.
- Examples of how instructional-design theories and models are applied in practice should be available
- The information presented in the textbook should be extended by showing different perspectives in the topics discussed
- The meaning of critical terms should be clarified
- The students should be supported in searching for additional resources and examples illustrating the course concepts via the WWW
- The students should be motivated and supported in discussing and sharing information.

Using the possibilities made available through the *TeleTOP* database-generated course-support system at the faculty (see http://teletop.edte.utwente.nl, and also Tielemans & Collis, 1998; De Boer & Collis, 1998a,b) a course-support environment was created with the following basic components: (a) a news/update area, for general communication from the instructor to the students; (b) a matrix-like roster, in which the weekly organization of the course is given, and linked to this extra study materials, links to discussions, opportunities for students to enter assignments and new materials into the course site, and for the instructor and other students to give feedback; (c) a communication area, supporting direct e-mail among all participants in the course; (d) a section with general information and background about the course; (e) a shared-workspace area where groups of students can work and discuss together on topics in the course; (f) a glossary, with communication options added so that students can suggest new entries or ask for clarification about terms; and (h) a resources area containing a large number of links to external resources relevant to the course, some to serve as prerequisite material, some for illustration of concepts and theories, and others to serve as enrichment and examples of professional interactions relating to instructional design. Figure 1 shows the roster of the course.


Instructional Theory 2

Roster

	Before the session	During the session		After the session	
Date and place	Selfstudy	Notes and assignment	Submitted assignments	Follow-up assignment	Submitted assignments
26.March.98 L-213		session 1 notes (Introduction)		Selection of Chapters for Presentation	Your Choices
2.April.98 L-213	Preparation for session 2	session 2 notes (Ch.1&2+Art:1)	Presentation of Group 1	Behaviorism, Cognitivism, Constructivism	Your Definitions & Comparison
23.April.98 L-213	Preparation for session 3	session 3 notes (Ch.3&4+Art:2)	Presentation of Group 2	Test: Phases of Systematic Design Models	
7.May.98 L-213	Preparation for session 4	session 4 notes (Ch.16;17;19+Art:3)	Presentation of Group 3	Discussion: ITT	Submitted Assignments
20.May.98 L-213/ IAC	Preparation for session 5	session 5 notes (Ch.21&22)	Presentation of Group 4	Extending Glossary	Your Entries
28.May.98	Preparation	session 6 notes	Presentation	Instructive	Your

Figure 1. Roster of the *Instructional Design Theories* course-support site

A closer look at the roster

The roster works as a course organizer. For each session, it shows the date and place of the session, gives links to self-study activities that should take place before the session, links to notes to accompany the face-to-face session, links to materials created by the students for presentation during the face-to-face sessions, and follow-up activities after the session. The session notes are prepared by the instructor to help the students deal with each of the chapters and topics in the course. The notes also allow the instructor to update the material, add links to views of other specialists, provide links for further exploration, and to illustrate concepts with examples and real-life applications.

There were three types of follow-up assignments: discussion questions, assignments relating to the creation of reports, and self-tests. For the discussion assignments, students took part in discussions relating to instruction-design issues available via the Internet. This serves to increase their sense of the application of the concepts in the study materials, and also helps them to articulate and defend their own ideas. They also discussed among themselves, using the shared workspace, each entering some reflections and then commenting on the reflections of the other students in their group. The instructor occasionally intervened, to support and motivate, but the main focus was on communication with others in the field as well as one's classmates. For the report-type assignments, students needed to search the Internet to find additional resources to support their ideas. Also, they posted their reports on the course site for peer-review. Again, the instructor coached and commented on an individual basis when useful. The TeleTOP course environment allowed the easy entry of comments and files, as well as feedback and follow-up to materials that have been entered; all the instructor and students need to do to type in their responses or upload previously created files. The entries are immediately entered into the course database and integrated into the course WWW environment. The self-testing was done with Java-enabled test items that provide immediate feedback after the student submits an answer. The students were free to make as much use of these resources as they wished. An important part of the course site was the glossary section. In the glossary, all terms in the course are defined, and external links provided to lead to more-detailed information about each term and concept. In addition, a communication form was provided so that students could immediately enter a suggestion for an addition to the glossary, or ask for clarification. The instructor would then respond, sometimes with an email, sometimes with a new entry in the glossary, sometimes by a further comment during the next face-to-face session.

Student Evaluation of the Course

At the conclusion of the course, the students responded to a questionnaire embedded directly in the course environment. The questionnaire contained 22 multiple-choice questions and 12 open questions. Among the main results of the evaluation are the following points:

- In general, the students enjoyed the site and especially appreciated the well-organized extra resources.
- The students immediately contributed to the site by adding their own PowerPoint presentation materials to support their class presentations. The students indicated they planned to continue using the resources for other courses.
- Although they appreciated the follow-up assignments, they often did not have time to carry them out if they were not given points but only offered on a voluntary basis.
- Students need an initial demonstration of the site, and how to use its features such as the shared workspace and the facilities for uploading and downloading files and giving comments. Students do not read the user manuals provided.
- Students appreciated being able to read the contributions of other students in the shared workspace.
- Students made particular use of the site when studying for the examination.
- Students appreciated a convenient way to communicate among themselves and with the instructor.

The students did make constructive critical comments about the design of the site, and the manner of integrating it into the course (i.e., its fit with the instructional design of the course). In particular, while they appreciate rich resources, they feel they lack the time to exploit them unless this time is included in the marking scheme of the course. This is especially true with discussions; in order to get a critical mass of discussion activity, students appreciate the stimulus of getting points for their contributions. Students also commented that learning from each other also has limitations: *Learning form the presentations of others is not always good, because they can tell wrong things or they cannot explain well. When the instructor explains, it is interesting, but there is often not* *enough time because of student presentations.* An evaluation of the 1998-1999 cycle of the course will be presented at the ED-MEDIA '99 conference.

Discussion

The site was used as a support for the course, to lead the students to decide for themselves what extra materials they wish to select and study. The goal is to support their increased self-responsibility for learning. But students also need a push, or a reward; in the following cycle of the course, points will be given to acknowledge participation in the discussions. The most important function of the course site was to stimulate a more-active learning process among the students, by providing valuable exercises and letting them participate in building the course site by finding or creating resources and sharing them with others. The purpose of the course site is more than putting instructional content in a form ready for study. If our aim as instructors is to coach students to think critically and to reason about concepts and issues, as well as having the ability and motivation for learning independently, then the instructional design of the course-support site should reflect these aims. For example, using the site to search for additional, and relevant, information and examples, and presenting them within the site so that the other students could reflect on each others' choices is a valuable activity for our aims. In the case of students all working in a language which is not their mother tongue (English), the asynchronous nature of the course site allowed them the time to construct their responses without the difficulties of speaking spontaneously.

Extending our experiences to other types of courses

Although this case study has focused on a particular course, it is our experience from working with the instructors of 30 courses within our faculty during the past year that our main conclusions are relevant to a large variety of courses. With all of these courses, the following guidelines have been appropriate, although the way of realizing them varies considerably from course to course:

- A WWW-based course-support environment should extend the boundaries of the traditional teaching that occurs in the classroom.
- It should support while challenging students' thinking.
- It should include a resource center for the investigation of a variety of information, with an emphasis on the students evaluating this additional information in terms of its meaningfulness to the course.
- It should support discussion, exchange of ideas, and peer evaluation, and these activities should be part of the graded activities in the course.
- It should allow the students to organize and restructure information as well as create and contribute their own resources.
- It should present a convenient way for students to participate in collaborate work and in the communication of ideas and questions, in ways that cannot take place in the classroom due to restricted time and the difficulty of making reflective comments in a classroom setting.

Critical to all of this is a user interface that makes contribution to the course site simple for both the instructor and students. Thus other major requirements in terms of the instrumentation of the course site are:

- The course site should allow students and the instructor to enter comments, and upload and download files, without having to know any technical aspects of the process.
- The access to the course site should be through the usual WWW browser, requiring no separate software for either instructor or students.
- All course-support resources should be integrated within a single WWW environment.
- Students should be co-builders of the course resources, and thus need to be able to see and give comments on the entries of their peers into the course site. Thus the course environment must grow during the process of the course, based on student entries, and thus must be flexible technically to handle this and still maintain the underlying database relationship.

Conclusion: Toward an Instructional Design for Course-Support Environments

The value of a WWW-based course-support environment depends entirely on how the environment is designed and how it is integrated into the rest of the teaching-learning process. But because of the newness of the WWW, instructional-design models for the whole instructional communication in which WWW sites are included have to be developed. Such models could retain the skills and insights of the personal instructor and at the same time make use of the time involvement, specialisation skills, sophisticated tools, and task division possible in the professional development team (Collis & De Boer, 1998b). This is the situation now at the University of Twente. We hope that the guidelines suggested in this article can contribute to an instructional-design model for courses making use of WWW-based support environments.

Note: This paper is a shorter version and revision of Dijkstra, Collis, & Eseryel (1998).

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Computers are not Books

Center for Digital Systems
Free University of Berlin, Germany
caumanns@cedis.fu-berlin.de

Dr. Nicolas Apostolopoulos
Center for Digital Systems
Free University of Berlin, Germany
napo@cedis.fu-berlin.de

Albert Geukes
Center for Digital Systems
Free University of Berlin, Germany
ageukes@cedis.fu-berlin.de

Abstract: Educational hypermedia is often seen as an improvement of textbooks. In this paper we show how educational hypermedia can be improved by understanding it as a completely new paradigm that has quite few in common with books. The benefits of features such as continuous media, user-driven interaction, layered structures, and adaptation can only be fully exploited if they are not just seen as additional possibilities for textbook writing.

A Change of Paradigms

Educational Hypermedia/Multimedia is a completely new paradigm and should be treated that way. This especially means that it can't be compared to books, it does not compete with books, and it has almost nothing to do with books. It does not make sense to read a novel from a computer screen as it does not make sense to learn statistics from a book -- even though millions of people did so for hundreds of years.

Especially for educational and informational purposes Hypermedia/Multimedia is the paradigm of choice, as it

- allows the integration of differently encoded media, such as text, graphic, audio and video,
- allows interactivity
- provides possibilities for non-sequential and even non-hierarchical structures,
- enables multi-dimensional navigation (hyperlinks, guided tour, glossary) and
- allows adaptation to the current users prerequisite knowledge and preferred learning model.

In this paper we describe some of the experience we made during the last four years developing educational hypermedia within the DIALECT project (*Digital Interactive Lectures*). This experience is based on an empirical evaluation (Weiber, 1997), user surveys, user interviews, and user observations. We will concentrate on the first four aspects, for more detailed information about adaptation see (Caumanns, 1998).

Multimedia

Computers are not books and information can be provided by other means than text (ask your kids!). We suggest that the media of choice for educational hypermedia should be animation and video. Animation in most cases is the best way to make abstract knowledge visible and therefor more understandable. Video stories help providing an authentic context for embedding the theoretical part of the application.

Since our first application in 1996 (Apostolopoulos et al., 1996) until now we have made a radical shift from text to video and animation as the main means of delivering information. Our first application about marketing had a rate of about one animation per seven screen pages and an average of less than 40 seconds of video and/or animation per screen page. The latest application we completed was about taxes (Buchmann & Geukes, 1998). It contained more animations than screen pages with an average of more than 4 minutes of video and/or animation per screen page. The average animation length nearly increased by a factor of two (from 98 to 167 seconds). The amount of text decreased as radical as the amount of continuous media increased.

The Use of Text

Currently most educational hypermedia applications that were not particularly designed for kids are still heavily based on text. Especially web-based educational systems still use text as the main media for transporting content. Many of these applications look as if someone transformed a book chapter-by-chapter into a set of hyperlinked HTML pages, without taking care of the differences between paper and computer screens:

- Reading speed from a computer monitor is about 25% slower than from paper (Nielsen, 1997a).
- Only 16% of web users read texts word by word (Nielsen, 1997b). This figure might be higher for systems not based on the WWW, but possibly even for these applications it won't exceed 50%.
- Images always catch more attention than text. Whenever there is an image, a diagram, or a video on a page, text is read last.

These figures don't imply that text is completely useless or waste of space, but they suggest to restrict the use of text to where it is best suited:

- giving short summaries,
- structuring screen pages, e.g. by headlines and subheadings, and
- listing items, keywords, links, etc.

Providing information just by text easily leads to inert knowledge - knowledge that might help a student to solve a test but never to solve a real-life problem. E.g. most textbooks and hypermedia applications about statistics contain a sentence like *"The median is more robust than the mean as it is not influenced by outliners."* Pupils will remember that (at least until the test) but only a minority of them will think about it and understand it. Providing this knowledge by an animation - e.g. by showing a distribution with its mean and median and slowly moving an single data point to the left or right - does not guarantee the students will be able to write such a well phrased sentence about robustness, but they will understand its meaning.

Especially rather abstract or more sophisticated concepts can best be mediated by animation or video, e.g. how a superscalar and superpipelined RISC processor works, or how certain distributions can be mapped to real-life problems.

Context and Authenticity

The advantages of video in general and video stories in particular are well known and have been discussed in detail by various authors (e.g. Bielenberg & Carpenter-Smith, 1996). Video is

- more motivating,
- more engaging,
- easier to remember,
- and has a higher content bandwidth

than any other known media. Further on, video is best suited for creating an authentic learning context (CTG, 1992). Especially for constructivistic approaches such as *Situated Learning* (CTG, 1992), *Digital Interactive Lectures* (Apostolopoulos et al., 1996), and *Cognitive Apprenticeship* (Collins, et al., 1989) a video story in most cases is an integral part of the application.

For all of our applications we try to create a story that not only provides a learning context but also shows the relevance of the topic. It is very important for the students to see that the knowledge obtained by the application can be useful for their private or professional life. The main actor of our stories always is either a student or a young employee, who is faced with a problem he or she cannot solve on his/her own. Help to solve the problem comes from various sources: professionals, friends, teachers, etc. These characters work as a bridge between the story and the theoretical part of the application, as they are the only ones who explicitly talk about theoretical aspects of the knowledge domain.

One of the drawbacks with continuous media we had to solve was the hyperlink-problem. Using text with educational hypermedia is attractive as currently text and images are the only media that can contain embedded hyperlinks - either as hot words or as hot zones. We solved this problem by introducing *hot frames*. A hot frame is a very simple yet powerful tool to bind a certain frame of a video or animation to an event. We used these hot frames to provide a list of hyperlinked keywords - whenever a certain concept is mentioned in the video an appropriate keyword is displayed. Clicking this keyword, the user either gets additional information about that concept by a popup window or a jump to the screen page containing information about the concept.

Interaction

Computers are not books and users should be able to do more with a hypermedia applications than just switching pages. Interactivity is certainly one of the most over-used buzz-words in our business: A video is called interactive if it can be stopped; a graphic is interactive if it contains hot zones; a text is interactive if it contains hyperlinks; a screen page is interactive if it contains a *next page* button; a diagram is interactive if it can be scaled; ...

Interaction is the most powerful tool we have at hand to help users learning new and abstract concepts. The obvious reason for the strength of interaction is that it inherently supports the idea of "learning by doing". The not so obvious reason is that it permits users to check their newly obtained knowledge.

Unsupervised Interaction

Interaction in educational hypermedia in many cases is unsupervised; there is no right and no wrong. Typical tasks with unsupervised interaction are "Change the data and look what happens" or "Connect these objects and check the result". An example in the domain of statistics would be a raw data set and a boxplot: The user changes the raw data, the boxplot changes. The system does never say, that any of the changes done was right or wrong.

Especially when abstract concepts can be visualized easily - e.g. by diagrams - unsupervised interaction follows the idea of "learning by doing". Users can prove their own theories or even develop new ones by "playing" with the system.

In our current application about statistics unsupervised interaction is realized by the *Statistics Laboratory (StatLab).* The Statistics Laboratory is a toolbox of visual and statistical objects including worksheets, data generators, various diagram types, text fields, and an S+ interpreter. Connecting these objects, students can create complex filter graphs, where data "flows" from a source (e.g. a worksheet) through various filters (e.g. S+ Interpreters) to a sink (e.g. a diagram).

The basic ideas that led us to the Statistics Laboratory were

- **Immediate Response:** Whenever the user changes data at the source of the filter graph, these changes are immediately visible in all objects that are somehow connected to the source.
- **Unlimited Possibilities:** *StatLab* puts nearly no restrictions on either the kind of data used or on the calculations performed. This allows users to experience their own topics. They choose the data and the method. The drawback of this flexibility is that any kind of supervision of the users actions is impossible (see next section).

Other examples for unsupervised interaction in an application about statistics can be found in (Schulmeister, 1996).

Supervised Interaction

The latest application we finished contains two kinds of interaction: multiple choice questions and spreadsheets for solving some real-life problems that were derived from the video story. Before the initial test phase we thought that users would favor the (unsupervised) spreadsheet problems as they were "more interactive" (users could enter arbitrary numbers and formulas, visualize the data in various ways, etc.) while multiple choice questions are rather "boring" in a way that interaction is reduced to clicking a radiobutton. After the first test phase we knew that it was just the other way round, as one of the mostly stated suggestions for improvements was "There should be more multiple choice questions".

Multiple choice questions are an example for supervised interaction: the user clicks a button or enters a number and immediately gets a response whether he was right or wrong. The problem with supervised interaction is that its coding complexity increases exponentially with the possibilities left to the user. Multiple choice questions are simple: The user can only select between a fixed number of choices, some of them are right and some are wrong. If checkboxes or radiobuttons of a multiple choice test are exchanged by edit fields where users can enter their answer as natural language, things start getting difficult. They even get harder if a problem is made up of several smaller subproblems which might be solved in arbitrary ways and in arbitrary order.

In order to provide supervised interaction not the user but the application must be in control. Each action of the user must be tracked and matched with a list of correct and wrong solutions. Restrictions must be set up to prevent the user from doing something completely silly that is not contained in the right-and-wrong list. All problem-solving interaction that contains some kind of mathematics is faced with the "magical number"-problem: e.g. The user introduces a new variable named "x" with a value of 42. What does 42 stand for? Is there a reasonable meaning on "x"? We don't know and a piece of software surely cannot know either. To prevent this problem, generation of numbers may only be allowed by using a well-defined set of functions. But would you like to force your users to type in a more or less cryptic command just to sum up 1 and 1?

Within the last years some progress has been made in the area of supervised interaction without restricting the user too much (e.g. *Cognitive Task Analysis* (Lovett, 1998)). But most of this progress has been made in the domain of mathematics, statistics, and programming languages, where the alternatives of the user are inherently restricted to either numbers or a well-defined set of symbols. Future will show if some of these ideas can be mapped to less structured and/or less formal domains such as economics or language learning.

Structure and Navigation

Computers are not books and access can not only be provided by a table of contents. To access the contents of a book the table of content or the index is used. To access the contents of most hypermedia application the table of contents or the index is used as well. Still most educational hypermedia are build on hierarchical structures: two levels of headings lead to sequences of screen pages.

There is nothing wrong with hierarchical structures as in most cases they reflect the structure of the knowledge domain of interest very well. They just get inappropriate for hypermedia applications if there is more than one reasonable structure on the knowledge domain or if they provide the only possibility to access.

Tracks in Hyperspace

One of the experiences we made is that users - especially if they are unfamiliar with either the contents or the presentational form of educational hypermedia - like to follow a sequential track. This track may as well be a video story as a guided tour or some kind of "where to go next" hints.

As a consequence of this experience our current application about statistics contains two sequential tracks: a video story as a central thread, and a collection of problems for explorative learning. The theoretical part of the application is structured as a layered hierarchy of concepts (e.g. descriptive statistics, univariate data, measurements, mean and median, calculating the mean from classified data). An user may enter the application either by watching the story, by solving problems, or by working through the theoretical part.

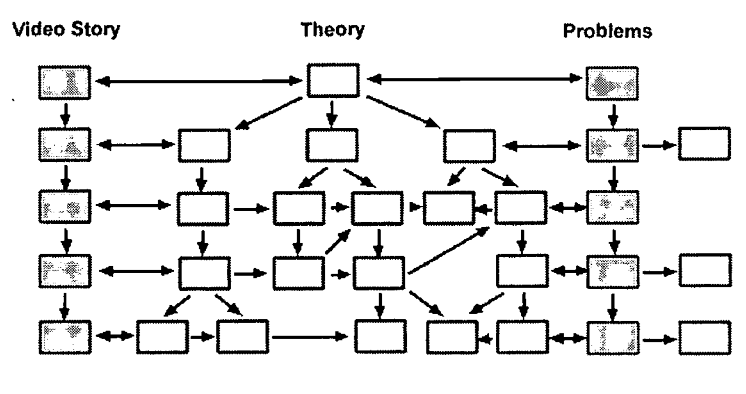

Figure 1: The logical structure of *Statistics Interactive*: Two sequential tracks - story and problems - and a "classical" tree-structured main-part.

Switching between the three parts of the application is made as easy as possible:

- The video story can be split into a number of small clips. After each clip users can either continue watching the story or switch to the theory to glean information about the concepts introduced by the last clip.
- If the user needs some further hints while working in the *StatLab*, he/she can always jump to the theoretical part to learn about the concepts or formulas required.
- After working through a concept in the theoretical part of the application, a user may either jump to the *StatLab* to practice and proof his/her new knowledge or go to the story track to see how this knowledge is used to solve a real-life problem.

Providing multiple ways to access the content of an application will be attractive for both inexperienced and experienced users. Learning to understand, learning to pass an examination, learning about a whole domain, and looking up a single keyword or formula is all supported by providing multiple tracks.

Layering

Some knowledge is more important, fundamental, or useful than other knowledge. Knowing about purpose and application of a concept is more fundamental than knowing its definition or formula. Knowing a formula is more useful than knowing its proof.

Currently many hypermedia applications still make this layering of importance only explicit by using textual explanations. We prefer to make it explicit by means of structure. Therefor we suggest a cascaded, four-layered content structure with the most fundamental and most important knowledge at the top layer:

- **contextual knowledge**, e.g. what is the purpose of measures of central tendency
- **conceptual knowledge**, e.g. what is the arithmetic mean
- **abstract knowledge**, e.g. how to calculate the arithmetic mean
- **additional knowledge**, e.g. proofs and less important measures

From each screen page a user can either go on to a page about the next concept on the current layer or jump to the first concept of a deeper layer. E.g. the page about measures of central tendency on the contextual layer has two successors: contextual knowledge about measures of dispersion and conceptual knowledge about the arithmetic mean. The page about the mean on the conceptual layer has also two successors: the median and calculating the mean from raw data.

By allowing both horizontal navigation (staying on the same layer) and vertical navigation (jumping to a deeper layer), users will easily see how important and how fundamental a certain concept or topic is for understanding the whole knowledge domain of interest. By layering information we further on allow users first to get an overview of the whole domain before getting into details.

Conclusion

In this paper we tried to point out how educational hypermedia currently is still captured by many old textbook paradigms. Especially the overuse of text, missing interaction, and pure hierarchical structures very often hide away the advantages of this new teaching paradigm. To overcome these deficits we propose to put very strong emphasis on the subterms "multi", "hyper", and "media" in "educational multimedia/hypermedia":

- Text is only suitable if it is printed out, it is not suitable if it must be read online. **Continuous media** should be used instead whenever possible. Low-bandwidth yet high-quality encoding techniques like streaming video (e.g. *RealMedia*) or vector animation (e.g. *Macromedia Flash*) make video and animation the media of choice even for web-based applications.
- **Interaction** is hypermedia's sharpest sword. It not only supports the idea of "learning by doing" but even allows users to proof their newly obtained knowledge. An optimal interaction design should be unrestricted, users should be able to click, switch, or enter whatever they want. This demand is difficult to uphold if interaction is supervised as keeping track with and interpreting the users actions usually is a task of exponential complexity.
- Hypermedia applications should be **structured** in a way that allows for multiple access. By providing a sequential story or case study together with a hyperlinked theoretical part the demands of both novice and experienced users can be satisfied. Differences in importance and relevance of topics and concepts should be made explicit by structural means.

- **Navigation** should be horizontal and vertical, that the user might either navigate on the same layer of abstraction or go into detail about a certain topic by switching to a more concrete layer. Guided tours and overview maps should always be provided as alternative ways of navigating through the application.
- A **video story** cannot only be used for motivating and for creating a learning context. It is also well suited as a navigational item as it provides users with a central thread through the application.

We are going this way of strong definition from conventional textbooks for four years now. When we started, we were less radical than we are now. We thought that users always wanted something familiar, but that was wrong: users don't want something familiar - they want something good!

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Information Location in Instructional Hypertext: Effects of Content Domain Expertise

Diana Dee-Lucas
Department of Psychology
Carnegie Mellon University
Pittsburgh, PA 15213 USA
E-Mail: dd7t@andrew.cmu.edu

Abstract: This experiment examined the effects of content domain expertise on the ability to identify goal-related units on a hypertext content map. Novice learners based their unit selections on similarities between the wording of the unit titles and learning goals (i.e., short-answer questions). Wording similarities had significantly less effect on the selections of experts. Experts' and novices' confidence ratings indicated that both groups were able to predict accurately the probable correctness of their selections. These results show that novices studying hypertext may select information on the basis of superficial text features, while experts can use prior knowledge to identify goal-related units. The fact that novices had less confidence in their incorrect selections suggests that they may readily correct these selections with further use of the content map.

Introduction

Instructional hypertexts can potentially facilitate study efficiency by permitting students to determine the order and content of their learning material according to their individual needs. However, efficient learning from hypertext depends on how easily readers can locate the information required for the study goal. To aid information location, many large instructional hypertexts provide an overview of the text through the use of content maps (Dee-Lucas & Larkin, 1995). Content maps display titles indicating the subject matter of the hypertext units (i.e., brief segments of information in the hypertext). Students select units to read by clicking on the titles on the map. This experiment investigated how learners' expertise in the hypertext content domain influences their unit selections from a content map. It compared novices' and experts' ability to identify hypertext units relevant for answering short-answer questions when the wording of the questions varied in its similarity to the unit titles on the map.

Subject matter expertise influences the cues readers use to guide text processing when studying traditional texts. For example, novices studying science texts consider the same information to be more important when it is expressed in the form of an equation as opposed to a written sentence, while experts are not influenced by information form in their importance judgements (Dee-Lucas & Larkin, 1991). Novice readers rely to a greater degree than experts on superficial characteristics of the text structure and content to guide text study (Kieras, 1980, 1985; Dee-Lucas & Larkin, 1986,1988a). Experts use their knowledge of the content domain to develop effective study strategies (Alexander, Kulikowich, & Jetton, 1994; Dee-Lucas & Larkin, 1988b; Spilich, Vesonder, Chiesi, & Voss, 1979).

Traditional text research suggests that readers' subject matter expertise will influence how they identify goal-relevant units on a hypertext content map. The initial unit selections made by novices may be based on superficial text features, such as wording similarities between the learning goals and unit titles. If so, the accuracy of their selections would depend on how well the unit titles matched the learning goals. Because experts can use their knowledge of the subject matter to guide unit selections, the accuracy of their selections may be less dependent on the degree of similarity between the goals and units.

This experiment examined the effects of wording overlap between unit titles and short-answer questions on the units selected by experts and novices from a hypertext content map. Students were given two sets of questions and were asked to identify on a content map the units that they thought contained the answers. One question set included all or part of the title of the goal-relevant unit within the questions; the other set posed the same questions without the wording overlap. It was expected that novices would look for wording cues to select units, and therefore would be better able to identify the correct units when the titles were incorporated into the questions. Experts were expected to use their knowledge of the content domain in selecting units, and thus perform similarly on both question sets.

Method

Materials

The content map was taken from a hypertext about the scientific measurement of length and time (see Figure 1). Because the goal of the experiment was to determine the effects of expertise on unit selection, only the hypertext content map was used. Prior research using the complete hypertext indicated that students were able to use this content map effectively when studying for a variety of learning goals (Dee-Lucas, 1996b).

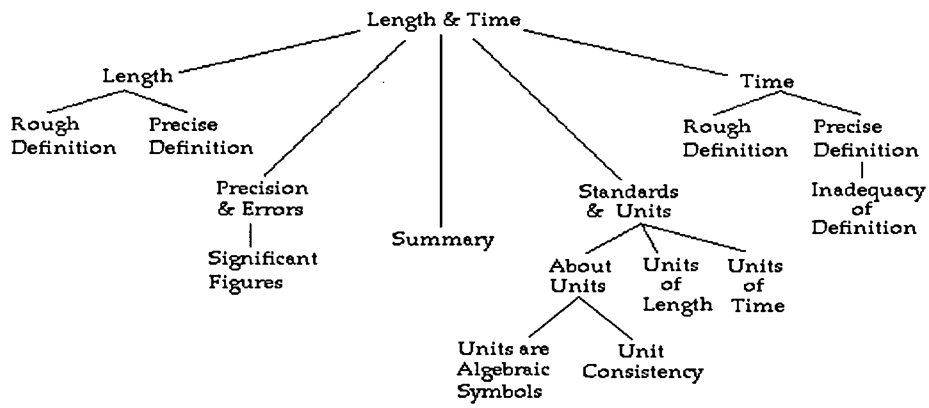

Figure 1. Hypertext content map.

A set of six short-answer "target" questions was developed, with two versions of each question. In one version, the questions contained all or part of the titles of the units providing the answers (i.e., "Overlap"). The other version contained the same questions without the wording overlap (i.e., "No Overlap"). Some of the questions are shown below.

Unit Title	Target Question without Overlap	Target Question with Overlap
Significant Figures	How much variation would be expected in a measurement written as 1.524 m?	How much variation would be expected in a measurement written with 4 significant figures (for example, 1.524 m)?
Unit Consistency	What makes this equation obviously false: **x** m = **y** ft/s (where **x** and **y** are numbers)?	What inconsistency makes this equation obviously false: **x** m = **y** ft/s (where **x** and **y** are numbers)?
Standards & Units	What does "SI" stand for?	In specifying standards and units, what does "SI" stand for?

In addition to the six target questions, three "distracter" questions were included that did not have the same pattern of wording differences as the target questions. Both versions of the distracter questions contained wording suggesting specific units as potentially relevant. The No Overlap distracters signaled an incorrect unit as relevant; the corresponding Overlap questions signaled the both the incorrect unit and the correct unit as possibly providing the answer to the question. Two versions of a distracter question are provided below.

Unit Titles	Distracter Question without Overlap	Distracter Question with Overlap
Precise Definition of Length (incorrect)	What is defined as the distance traveled by light in a vacuum during a specific period	What unit of length is defined as the distance traveled by light in a vacuum during a

Units of Length (correct)	of time?	specific period of time?

In the No Overlap distracter, the phrasing "defined as the distance traveled" suggests that the unit "Precise Definition of Length" might provide the answer. The parallel Overlap version directly signals "Units of Length" as important by including this title in the question, but also includes the wording indirectly suggesting that "Precise Definition of Length" might be relevant. Thus the Overlap versions of the distracter questions suggested more than one unit as the potential source for the answer to the question. The distracter questions were included to help ensure that readers did not detect a pattern between the two question sets.

Procedure & Participants

The participants in the experiment were 16 physics graduate students (experts) and 16 history graduate students (novices). The study was conducted as a paper-and-pencil task in order to allow greater flexibility in data collection. Participants were given the content map and one of the question sets. They were instructed to write down the title of the unit that they thought contained the answer to each question, and to indicate their confidence in their response using a 1 (very sure) to 5 (just guessing) rating. They were told that they could use the same title for multiple questions.

There were two sessions. Participants received the No Overlap questions in the first session, and the Overlap questions in the second session. The questions were given in this sequence to examine the extent to which readers' ability to identify question-related units improved when portions of the unit titles were incorporated in the questions. The second session was conducted at least 5 days after the first to minimize the effects of completing the first question set on responses for the second. Readers' did not have their responses to the No Overlap questions available during the second session.

Results

All data were analyzed with an analysis of variance including expertise (expert vs. novice) as a between-subjects variable and wording overlap (overlap vs. no overlap) as a within-subjects variable.

Ability to Identify Question-Related Units

To assess readers' ability to identify question-related units, the proportion of correct unit selections for the target questions was analyzed. The results indicated significant main effects due to expertise and wording overlap, and a significant interaction between these two variables (see Figure 2).

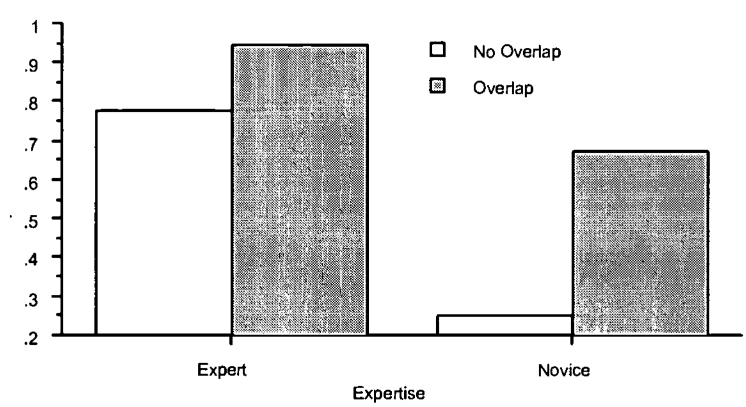

Figure 2. Mean proportion of correct unit selections by each group for each question set.

Experts made more correct selections than novices, and both experts and novices performed better on the Overlap than the No Overlap questions. However, the improvement in performance on the Overlap questions was greater for novices than experts. These results indicate that both groups used wording overlap as a cue for information location, but experts did not require this cue to the same extent as novices. Additionally, experts performed significantly better than novices on the Overlap questions, indicating that subject matter expertise provided an additional advantage beyond the wording cues for identifying goal-related units.

The unit selections for the three distracter questions were also analyzed. The results indicated only a significant effect of wording overlap, with both groups making more correct selections for the Overlap distracters (a mean of .48 correct) than the No Overlap distracters (a mean of .18 correct). This indicates that readers with the Overlap questions selected on the basis of title overlap as opposed to the indirect wording cues (signaling the incorrect unit). Although there were few questions in this set, the lack of effects due to expertise suggest that both groups experienced a similar degree of difficulty when the questions contained misleading or multiple selection cues. These results suggest that experts may be influenced by wording cues when plausible alternative units are suggested by different information sources (i.e., prior knowledge, indirect wording cues, wording overlap).

Changes in Unit Selection

To further examine differences in the use of wording cues, the proportion of unit selections that differed for the No Overlap and Overlap versions of the target questions was analyzed. The results indicated a significant effect of expertise, with novices changing a mean of .63 of their initial selections and experts changing a mean of .20. This result reflects differences between groups in their ability to identify question-related units, and further indicates that novices used wording cues in making their unit selections.

A parallel analysis of the three distracter questions indicated a trend towards more changes by novices which did not reach significance ($p<.077$). Novices changed a mean of .60 of their initial selections, while experts changed a mean of .44. The lack of a significant effect of expertise again suggests that experts had more difficulty with the distracter than target questions.

Confidence in Unit Selection

To determine if experts and novices differed in their ability to predict the accuracy of their selections, the mean confidence ratings assigned to correct and incorrect responses by each reader were analyzed. Because readers made more errors on the distracter questions, both target and distracter questions were included in the analysis to provide more data for assessing the relationship between confidence and response accuracy. The results indicated significant main effects of expertise, wording overlap, and accuracy, and an interaction between expertise and wording overlap (see Figure 3).

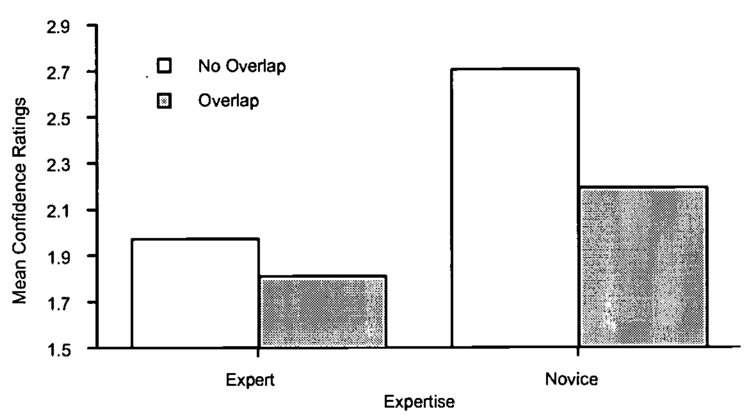

Figure 3. Mean confidence ratings given to each question set by each group.

Both groups of readers had greater confidence in correct selections, and experts were more confident in their responses overall than novices. However, the interaction showed that while experts were equally confident in their responses to both versions of the questions, novices were more confident of their selections for the Overlap questions. This interaction is consistent with differences between experts and novices in their ability to identify the correct units. This again suggests that experts relied on their prior knowledge in selecting units, in that their confidence ratings were independent of question wording. Novices, on the other hand, were more confident when the questions included wording overlap, indicating that they used wording cues in selecting units.

Discussion

Goal-directed learning from hypertext depends on the ability to select and organize the relevant text content. The results of the current research indicate that familiarity with the text subject matter influences how students identify goal-related units on a content map. Novices used wording similarities between questions and unit titles to guide unit selections, and had difficulty identifying goal-related units without such cues. Experts were also influenced by question wording, but to a much lesser degree than novices. This suggests that experts were able to use their prior knowledge to determine which units contained the information needed for the learning goals.

The results of the current research indicate that expertise is more likely to influence hypertext study when the hypertext lacks structural and/or content-level support for selecting goal-appropriate content (Dee-Lucas & Larkin, 1995). Such support would probably not be important for experts, but would be helpful to novices in locating the information they needed. McDonald and Stevenson (1998) reported similar findings in their comparisons of more- and less-knowledgeable readers studying differently structured hypertext. They found that prior knowledge facilitated information location when the hypertext lacked cues as to the content structure of the subject matter, indicating that the knowledgeable readers were able to use prior knowledge to structure the content. Research by Dillon (1991) also suggests that subject-matter experts have an advantage in being able to rely on familiar domain-specific organizations to guide electronic text study.

These findings are also consistent with research showing that novice learners use hypertext more effectively when the access facility provides detailed information about the text content. Dee-Lucas (1995, 1996a) compared novice learners' ability to complete a variety of learning goals when the hypertext content was divided into many small units (with relatively specific unit titles) and fewer larger units (with more general unit titles). The content map displaying many small units facilitated information location for a greater variety of goals. This finding may have been due to differences in the specificity of the unit titles. The more specific titles of the smaller units may have provided a closer match to the wording of the learning goals than the more general unit titles. The general titles may have not provided enough wording overlap to prompt selection of the relevant units for some goals. The current research indicates that the Dee-Lucas findings would not necessarily generalize to experts because they do not rely as extensively on the match between unit titles and learning goals in selecting units.

Although novices in the current research had more difficulty selecting goal-related units, their confidence ratings indicate that they were able to assess the potential accuracy of their selections. There was no difference due to question wording in the confidence ratings of experts, but novices were more confident in their selections for the Overlap questions. Both novices and experts had more confidence in correct than incorrect selections.

The fact that novices recognized when their selections were not well-founded suggests that they may be able to readily correct their selection strategy with repeated use of a hypertext. Learning from hypertext requires the student to make decisions and predictions about the relationship between the information in the text and the requirements of the learning goal (Mohageg, 1992; Wenger & Payne, 1996). If novices recognize when their selections are tentative, they may be more likely to attend to content cues within the units which would enable them to subsequently make correct choices, increasing their study efficiency over time.

The findings from this research indicate that the effects of expertise on hypertext study are mediated by the relationship between the study goals and the information access facility. Subject matter expertise can increase study efficiency when the access facility does not provide a clear indication of the location of goal-related content. These findings emphasize the central role of the access facility in determining the effectiveness of hypertext for novice learners who lack prior knowledge to guide text study. From a methodological viewpoint, the findings indicate that research investigating variables influencing information location (e.g., hypertext structure, learners' background, content domain, etc.) needs to take into account the relationship between the study goals and the access facility provided in the experiment in interpreting the effects of other variables.

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Web-Based Course Authoring Tools: Pedagogical Implications

Nada Dabbagh, Ph.D.
Assistant Professor Instructional Design and Development
Graduate School of Education
George Mason University
USA
email: ndabbagh@gmu.edu

Brenda Bannan-Ritland, Ph.D.
Assistant Professor Instructional Design and Development
Graduate School of Education
George Mason University
USA
email: bbannan@gmu.edu

Kathleen Flannery Silc, M.Ed.
Independent Instructional Designer and Distance Learning Consultant
USA
email: ksilc@concentric.net

Abstract: This paper reports on the findings of an evaluation conducted on Web-based course authoring tools. A comprehensive framework encompassing pedagogical, institutional, and ethical aspects among others, was used to examine the instructional effectiveness of the online learning environment by applying the framework to completed courses rather than assessing the specific features of the tool under investigation. A review of these courses and the attributes of the tools used to deliver them revealed several conclusions. In order for Web-based instruction to be effective it must be pedagogically driven, dynamically designed, interaction oriented, and content specific. Focus should be placed on designing a pedagogical approach appropriate for the content, inclusion of organization and interaction strategies that enhance the student's processing of the information, and integration of the medium's attributes to support the designated goals and objectives of the course.

Introduction

The move to online technologies is an evolving and dynamic process of investigation particularly in the area of examining the ability of such technologies to improve the teaching and learning process. In the case of Web-based course authoring tools (also known as Internet-based training tools), several evaluation frameworks or guidelines have been used to determine the degree of success of those tools in designing, delivering, and managing instruction. For example, Hansen and Frick (1997) suggest four areas that should be addressed by a Web-based course authoring tool for it to become a standard for the development of Web-Based Instruction (WBI): presenting information, providing human interaction, assessment of learning, and course management. Another example is the framework used by PC Week Labs (August, 97) in conjunction with its corporate partner, Wisconsin Technical College System, to evaluate courseware authoring systems for Web-based training. The products used to create the training programs and the resulting programs themselves were judged on conformity to the corporate and education landscape, exploitation of the Internet/intranet, manageability, flexibility, and ease of use. In another effort aimed at helping educators and administrators select new online delivery methods, Landon (1998) conducted an analysis of online delivery software in which he describes and compares these applications by focusing on their technical specifications, instructional design values, media capabilities, features/tools, ease of use, accessibility to persons with disabilities, and potential for collaboration and connectivity. Although useful, these frameworks (and others) have focused on the technological aspects of the features that enable the development of online instruction (Dabbagh & Schmitt, 98) and have adopted a piecemeal approach to the evaluation process which makes it difficult to form an authentic representation of the learning environment generated. As asserted by the Australian National Training

Authority (ANTA), Web-based authoring tools seem to be adhering to a common pattern of development and analysis:

> An emerging pattern for the development of online courses is that of a staged and incremental process. In the first round of investigations, the focus for developers is more on understanding the potential of the technology and exploring its features (March, 98).

The purpose of this paper is to use a more comprehensive framework to evaluate Web-based course authoring tools encompassing pedagogical, institutional, and ethical aspects among others, and to examine the instructional effectiveness of the online learning environment by applying the framework to completed courses rather than assessing the specific features of the tool under investigation. The term used to describe such courses in this discussion will be Web-Based Training (WBT).

The Framework

The proposed framework known as The Framework for Web-Based Learning (thereafter referred to as WBL Framework), was developed by Khan (1998) and consists of eight dimensions: pedagogical, technological, institutional, ethical, interface design, resource support, online support, and course management. Each dimension has various items addressing its constituents in relation to Web-based learning environments. For example, the pedagogical dimension addresses issues such as instructional goals and objectives, the overall design approach of the course, content sequencing and organization, instructional methods and strategies, the instructional medium (the Web in this case) and the extent to which the course uses its attributes, accuracy of subject matter, and learner assessment. For more details about this framework and its dimensions see: http://www.gwu.edu/~etlkhan/keynote/dimensions/framework1.html.

There are three issues to consider when attempting to answer this question. First is the issue of the transformation that traditional courses experience when redesigned for Web delivery. Typically such courses undergo a "pedagogical reengineering" (Collis, 1997) because of some of the inherent features of the Web that are integral to the design of WBI (Dabbagh & Schmitt, 98). Second is the purpose of the Web-based course in the learning environment. Is the course a supplement to on-campus/on-site instruction or is it intended as a distance learning alternative in which the instruction, interactions, and feedback are delivered via the Web? Third is the type of authoring tool used to develop the course for Web-delivery and the features it affords the developer. For example, integrated application suites (authoring tools) refer to applications that provide specific tools designed for each of three user groups: learners, instructors, and technical administrators whereas component applications refer to more specialized applications that generally provide few instructor tools (Center for Curriculum Transfer & Technology, http://www.ctt.bc.ca/landonline). We will address these issues by applying the WBL Framework to six WBT sites that have been developed using six different Web-based course authoring tools (see table 1). We will then use the results of this evaluation to determine the extent to which the technology of delivery, in this case the Web-based authoring tools, can shape the pedagogy of courses and assist course developers in focusing on instructional considerations when capitalizing on the attributes of the medium.

The Courses

Selecting the courses was not an easy task. We searched for complete courses that demonstrated a full and authentic use of the application. All of the product Web sites contained at least one demonstration course that could be accessed by registering and receiving a password or a log-on ID. These product site courses, however, varied in their ability to demonstrate all of the components of the authoring tool. A few of the courses were designed and taught by instructors for accredited programs, but no longer included the student exchanges, student projects, tests, and complete content. Other courses were designed specifically to demonstrate the product and therefore were not actually used by instructors or students in a learning context. In the quest to obtain courses that reflected a more realistic use of the Web-based course authoring tool, we were able to obtain access to a few uncorrupted accredited courses which we felt were sufficiently representative of the authoring tool and therefore befitting the purpose of this chapter.

The Evaluation

Due to the comprehensiveness of Khan's framework, which includes eight dimensions and more than sixty sub-components, a simplified strategy was selected for our informal evaluation of these courses. Mapping the framework to the various courses revealed specific strengths and weaknesses of each course that could be aligned with many of the framework's components. To avoid unnecessary complexity, we chose to focus on the major course attributes in relation to the framework. The major attributes of each course which emerged, both positive and negative dictated our interpretive evaluative approach using the WBL Framework.

Marketing Certificate in Small Business Management

This comprehensive demonstration course highlights many features of WebCT. Most notable is the student guidance for on-line learning and navigating the course as well as excellent content organization. Developed in an on-line mode format (Brenda, is this redundant?), this course provides the student with extensive explanation of the purpose, objectives and activities involved in addition to directing students to recommended approaches for learning the material in this delivery format. The instructional content is thoroughly presented in a program-centered manner (WBL framework) providing the student with clear and concise partitioned segments of content. There is evidence that the instruction was originally interspersed with interactive elements such as forms, and assessment elements such as on-line quizzes.

On first glance, the course seems to represent a more objectivist pedagogy (WBL Framework) primarily in delivering content but inside collaboration is also included with discussion email and on-line chat mechanisms as well as conferencing bulletin board sessions that automatically create a conference topic relevant to the current content section chosen. Administration and tracking mechanisms are also included providing some metacognitive suppport for the student in resuming their place in the course and tracking progress through presenting the number and history of pages viewed and section printing capabilities (WBL Framework). Assessment of student learning through on-line quizzes and case study responses are evident; however, it is not clear how the students receive feedback on their responses. Efforts for formative evaluation on the course are elicited through various methods of response including email and forms.

SUNY TopClass Virtual Lounge & HelpDesk

WBT Systems, the distributor of TopClass, recommended a course designed and conducted by William Graziadei of the State University of New York, Plattsburgh, as a demonstration of their Web-based course delivery system. In spite of its title, "SUNY TopClass Virtual Lounge & HelpDesk (STCVL)," this is a complete course. STCVL is meant to provide a self-paced guided training for SUNY students and instructors who will participate in online teaching and learning using the TopClass application. The course overview states that Professor Graziadei hopes the discussion portion of the course will become a forum for faculty and students of different disciplines to share their experiences with online education.

The course overview encourages contributions through email (which is always available on the tool bar at the bottom of each screen), and discussions can be accessed through the course homepage, however, group interaction and collaboration (WBL Framework) are not an integral part of the course design. Only one folder, the "live interactive tutorial," appears to provide interaction between student and instructor. Unfortunately, access to this tutorial is restricted to the SUNY community. Another weakness of the course is the absence of a search engine, index, or glossary to help students who return with specific questions, sift through the profusion of information presented under each topic/unit. Also, considering the amount of information in some folders, the topic of Online Education could have provided many more outside links to resources on distance learning and instructional design strategies relevant to this delivery medium.

Effective Business Writing English 1007

The purpose of this course is to be delivered half the time in a face to face format and the other half fully online. This is known as the mixed mode compared to an adjunct or an online mode. In an adjunct mode, the online portion of the course is intended as a supplement to enhance traditional classroom instruction. The online mode is when the network serves as the primary environment for course discussions, assignments and interactions. These modes are referred to as 'modes of teaching' by Virtual-U; the tool used to develop this course, and are offered as guidelines for instructors in the Instructor Tools and Support component of the tool.

The course begins with four options to choose from; course syllabus, course overview, course calendar, and glossary. These options are not standard. They can be customized to reflect different choices based on the content of the course thus providing structural flexibility (WBL Framework). The course syllabus is an advance organizer and contains hypertext links to the course topics, units, assignments, tests, activities, resources, and online conferences and discussions. The links encompass a wide variety of electronic media utilizing virtually every attribute of the Internet and the World Wide Web. They include text files, tutorials, audio files, video clips, animations, graphics, online resources (with built-in search engines), and PowerPoint files to present course content and learning activities, as well as, synchronous and asynchronous communication forums ranging from email to a virtual cafe for socializing. Although intricately rich in multimodal representations and interaction levels, the variety is overwhelming and could present a level of complexity for first time users. However, it is evident that online support, resource support, and inside and outside collaboration is demonstrated through the use of these features (WBL Framework).

With each of these views there are Use features that can be accessed by the student and the instructor to perform certain activities. This Use feature promotes a student-centered approach to learning, which is one of the underlying instructional principles that Virtual-U supports. The workspace interface is a good anchor point for the user and perhaps should serve as the primary navigational structure for the course. It will improve the user friendliness of the interface.

Health Care Management

Health Care Management first conducted in the fall of 1997 provides an example of a course delivered via Web Course in a Box (WCB) authoring software. The course is structured using face to face class sessions interspersed with at least five electronic seminar discussions. This demonstration course highlights the main features and aspects of the WCB software but is currently deliberately restricted in content and resources as well as corrupted by multiple users experimenting with the authoring tool. However, in reviewing the structure and content that is available, many attributes of the course and the software are revealed.

The primary strengths of this course are the instructor's apparent attempts at management (WBL Framework) and organization of the content within the software constraints in addition to adequately addressing the on-line support issues (WBL Framework) necessary for student participation. These factors have pedagogical as well as interface usability implications. The electronic seminars focus on discussions about the off-line readings. These discussions are well directed with specific objectives and clearly outlined expectations established prior to providing a link directly to the conference on that topic. This organization facilitates the discussion of a specific topic focusing student contributions and easily directs students to the related conference session. Additional management issues are addressed in the course such as providing a help section and learning links dealing with Web development skills, however, the relationship of these skills to the required assignments could not be clearly determined. Inside collaboration (WBL Framework) between students in the course is fostered by WCB's providing space for personal biographies as well as individual and public class email capabilities.

Hospitality Industry Law and Liability

LearningSpace featured Hospitality Industry Law and Liability, a course from the University of Wisconsin-Stout, Department of Hospitality and Tourism. The course was entirely Web-based having no classroom component. The class databases were modified to remove copyright material, student discussions, and student profiles. Only a few units of the course are shown in their complete form, however, those sections demonstrate both the efficient ordering of content to help the learner achieve the objectives (Kemp, Morrison, & Ross, 1994) and clear expectations of what the student is required to do (WBL Framework). The units featured in the "Schedule" section provide reading assignments, content and process objectives, the purpose of the unit, as well as student and instructor evaluation criteria. The WBL Framework suggests that the course promote inside collaboration for working on joint projects. The instructor of this course requires collaboration with team members on many assignments, such as critiquing case studies. Collaboration is facilitated by the LearningSpace structure. It provides a shared workspace for team assignments. Teams may choose to restrict access to this space to members only. A message appears on the assignment link to indicate whether the work is "In Progress," "Ready for Grading," or ready for "Instructor Review." Collaboration is further promoted through discussion, which may be directed to the entire class or to team members.

Programming Your Avilar VCR

This course is intended as standalone instruction. It is self-contained and designed using tried and true instructional design principles. The pedagogical philosophy used in the overall design of the course actually shapes the learning environment (WBL Framework). The course starts out with clear instructional objectives and user directions on "how to take the course". Using a frame-based interface, the course is conveniently divided into six modules: lesson, exercises, questions, review, resources, and assessment. Buttons for each of these modules remain accessible throughout the entire lesson, however they are disabled and enabled based on where the learner is in the lesson. One must complete a lesson module first; then complete related exercises, answer questions, get feedback, review the lesson, and take the assessment. The progress through the lesson is therefore dictated by the organization of the content (to a large extent) and proceeds from basic to more complex learning outcomes. Although there is not much structural flexibility (WBL Framework), it is possible to jump between course modules using embedded hypertext or the Course Contents menu. It is recommended, however, that first time learners complete the course in the intended sequence. The modules can later be used as a reference or a job aid if one forgets how to perform a certain function.

The assessment and questions modules demonstrate a variety of multiple-choice question formats that can be used to evaluate learners' mastery of learning outcomes. Equally evident is the feedback feature after each response and the instant grade reporting that follows an assessment. Web Mentor supports the use of email, conferencing, chat rooms, application sharing, and other synchronous and asynchronous interactions that foster collaboration and interactivity. The course content however was not appropriately matched to the capabilities of the delivery medium (WBL Framework) and the use of a familiar methodology in designing instruction for a new technology may have once again contributed to the under-utilization of the tool.

Discussion and Implications

As is often evident in face to face courses, the Web-based courses demonstrated a mix of methods, strategies, and pedagogical approaches. Various strengths and weaknesses were noted in each case when mapped against the WBL Framework. Some courses adopted an objectivist, straightforward approach of content segmentation and delivery for mastery (see Programming VCR - Web Mentor), while others capitalized more fully on the inherent collaborative attributes of the Web in providing students with shared workspace (Hospitality Industry Law and Liability - Learning Space) and a constructivist student-centered approach (Effective Business Writing - Virtual U). Most presented a clear, logical and organized format (SUNY Top Class Virtual Lounge and Help - TopClass) and well-directed objectives and expectations (Health Care Management - WCB) while some provided exceptional guidance for learners with recommended approaches to the material (Marketing Certificate in Small Business Management - WebCT).

In examining the courses and hence the Web-based authoring tools, we found that the WBL Framework is an effective tool for informal evaluation and a good guiding mechanism or checklist for the development of Web-based courses. Our position is clear in attempting to promote a more comprehensive evaluation of courses developed with these authoring tools rather than examining the tool itself. Educators do not evaluate a classroom course merely by the technology of delivery, (e.g. attributes of overheads, LCD display, teacher-directed discussion) therefore we should not discern the effectiveness of on-line learning environments merely by dissecting the delivery tool.

Our review of these courses and the attributes of the tools used to deliver them revealed several conclusions. In order for WBI to be effective it must be pedagogically driven, dynamically designed, interaction oriented, and content specific. Focus should be placed on designing a pedagogical approach appropriate for the content, inclusion of organization and interaction strategies that enhance the student's processing of the information, and integration of the medium's attributes to support the designated goals and objectives of the course. Developers of Web-based training and educational materials need to place emphasis on these tasks and view the technology in relation to its capacity to deliver the planned design. This focus is perhaps best promoted by ANTA:

> While we are constantly reminded that learning must be developed around learning needs, meeting educational objectives and producing viable graduates, the lure of 'exploring the technology' is often at the expense of equal investment in the underpinning educational design.

The intersection between pedagogical considerations and the attributes of the Web-based authoring tools may, in fact, yield the most educational impact. Our reviews of these courses showed that attributes of the technological tools may also influence the pedagogical aspects of the course. This has been previously demonstrated in a case study by Dabbagh and Schmitt (1998) whereby a course that was redesigned for Web-delivery underwent a pedagogical reengineering from a primarily instructivist pedagogy to a more constructivist one due to the focusing of the developer on the inherent attributes of the Web through the use of the authoring tool. Web authoring tools which include components that facilitate the team process, such as LearningSpace, promote the inclusion of collaboration as an instructional strategy. Therefore, if the content and planned strategy dictates a strong focus on students working together then taking advantage of the attributes of this particular authoring tool may in fact enhance the educational effectiveness of the course.

Unfortunately no one tool can deliver every possible instructional approach. The software tools seem to have some common attributes as well as individual strengths and weaknesses. Most current web-based course authoring tools can also be viewed as restrictive in nature due to the visual metaphors employed by each tool that place constraints on the organization of content and the potential learning strategies employed. This factor certainly can restrict the learning environment produced and may prompt the need for web-based tools that are more open-ended, comprehensive and customizable. Hedberg & Harper make the valuable suggestion that new metaphors for authoring should be developed to match current theory. This notion seems a good start, however, a comprehensive advisement mechanism included within Web-based authoring tools providing guidance in the areas of pedagogical approach, instructional strategy, and on-line support and resources, may go further to support the developer who is lacking instructional design skills.

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*(This paper is based on a chapter submission for an edited book on Web-Based Training by Badrul Khan).

The Effect of Hypermedia Presentation and Relevance on Peak Experience

Tom S. Chan, Dept. of Comp. Sci. & Info. Sys., Marist College, USA, tom.chan@marist.edu

Abstract - This study investigates the effect of hypermedia presentation, its activity relevance and the interactions between the two on peak experience. The results suggested that the activity content has major influences on motivation but presentation is a double-edge sword. Hypermedia presentation adds appeals to instructions that motivate students if they are used appropriately. When the content relevance is complicated, complex presentations can be distracting. Consequently, hypermedia elements should be used sparingly at the beginning of a lesson when challenges are high and students are unfamiliar with the material. As the lesson progresses it could be used gradually as the content challenges are reduced.

Introduction

Hanaffin and Dalton (1993) proposed new technologies facilitate instruction in six areas: adaptability, realism, hypermedia, open-endedness, manipulatibility, and flexibility. Technology brings realism to instructions with greater breadth and depth. Norman (1994) illustrated the situation with this example. A large screen with high-quality sound improves the ability to be captured by the events. The relatively small screen and sound system of the typical home television distance the viewer from the event. In any environment, an event best captures the attention and improve concentration when the sensory experience is maximized and distraction minimized. However, Moore, Burton and Meyer (1996) cited that while much of the evidence from research supports multiple-channel design to provide additional reinforcement, the overall evidence on its effectiveness is inconclusive. They proposed that human information processing has its limited and is subjected to overload. This proposal is supported by the cognitive load theory: our working memory limits our learning capacity. The prescription of instruction requires careful analysis to consider the memory load implication of the different combination of content and instruction, sequencing and pacing (Sweller & Chandler, 1994). Unfortunately, the prescription is mainly related to instructional contents. The impact of hypermedia presentation on learning and its interaction with contents are largely unexplored.

The Internet signifies different things to different people. While some often find it a frustration, others view its as an end in itself. They report a great sense of involvement and excitement. Working with new technology such as the Internet appears to induce flow experience (Miller, 1996; Norman, 1994). Flow is an optimal state described by Csikszentmihalyi (1975, 1982, 1985, 1988, 1990, 1994,1997). During flow, people become so intense that nothing seems to matter. The experience is so enjoyable that they will do it for its own sake. When people reflect on how it felt when they are in flow, they mention these aspects: (a) sensing that one's skills are balanced challenge; (b) engaging in a goal-directed activity; (c) receiving clear feedback; (d) feeling in control; (e) intensifying concentration, with a sense of (f) merging action and awareness; (h) disappearing of self-consciousness; and (h) distorting sense of time; and (i) experiencing great gratification that the activity is intrinsically rewarding. Flow represents a descriptive dimension that signifies some purer instances of intrinsic motivation. When highly intrinsically motivated, we become extremely aroused and experienced such emotion as flows (Deci & Ryan, 1985). As indicated by flow theorists, flow experience is affected by contextual factors, including the task structure and quality of presented information. This study was designed to investigate how task relevance and quality of presented information influent flow experience in instructional activities.

Perelman (1992) predicted demise of the traditional educational system. A new wave of knowledge technology, the hyperlearning technology, is coming. It enables anyone to learn anything, anywhere, anytime, with same effectiveness as classroom instructions. While business is relying less on traditional instruction, students from kindergarten through university are using technology as supplemental, not substitutes for formal classroom. Although the Internet has a limited reach today, it is growing exponentially. Statistics show that by the year 2000, 95% of public school will be connected to the "Information Superhighway". Despite the great hype and promise, and its ability to connect us to a vast amount of information in text, picture, animation and sound, this "great technology hope" also gives us a sense of déjà vu. Cuban's (1986) examination into the optimism, enthusiasm, hesitancy and frustrations of integrating technology and education revealed the great complexity of the issue. Unfortunately, the educational system is propelled into the "Brave New World" at great momentum, even if we are not quite ready, and its impacts are far from certain. In this age of expectation and uncertainty, the effect of new technology on learning is a critical research issue.

Methodology

Four groups of 20 students were randomly selected, then randomly assigned to a treatment. Searching for information is motivating because of the perceived need for the information (Krikelas, 1983). By seeking research information or browsing on irrelevant material, we change the motivation level. Embellishments increase novelty and complexity that positively affect motivation (Lepper & Cordova, 1992). Using hypermedia or traditional computer platforms, we also change the motivation level. With a 2x2 design, the two levels of content relevance and two levels of presentation quality are as the following:

1. Reading MS Word - students browsed over a text file about dinosaurs. The tasks were imposed not negotiated, and they were not told about the purpose of the activity.
2. Reading CD-ROM - students browsed on a CD-ROM on dinosaurs that contained image, audio, video coupled with a hypertext organization for non-linear navigation.
3. Searching on ERIC - students searched the ERIC via remoter connection with a monochrome text-based system, where they searched for material on a class project.
4. Searching the Web - students searched for material on the Web using a Netscape browser with a list of sites pertinent to their course project.

The Flow State Scale (FSS) was developed to assess flow during sport participation (Jackson & Marsh, 1996). It has 36-item, 5-point Likert-type scale, with 4-item for each of the 9 flow dimensions. The instrument was adapted for assessing flow in computer-based activity (Appendix). A score from definitely-5, agree-4, may be-3, disagree-2 and definitely disagree-1 point was assigned. Strong agreements suggested a high degree of flow, and flow subscales. The proposed FSS dimensions, and its construct validity have been theoretically supported by research (Csikzentmihalyi, 1988; 1990; 1992). Psychometric assessments of the original instrument (Jackson & Marsh, 1996), and the adapted instrument (Chan, 1998) reported alpha from .71 to .93.

Data was collected during class activities in spring 1998. At the last 40 minutes of a regular class session, students were ushered into a PC lab with the necessary computer application loaded for the randomly selected treatment. After 30 minutes, students were instructed to stop. They were asked to reflect upon their experiences during the session while completing the questionnaire. The procedure was repeated for the next class section with the next randomly selected treatment until all treatments were administrated. Univariate Normal Plot, Hartley Fmax, reliability and correlation analyses were conducted to examine the data characteristics. Data were examined with two-way ANOVA on the total and subscale scores of the Adapted FSS. If the interaction effect was significant, simple main effect for the content and presentation will also examined.

Results

Out of the total enrollment of 97 students, 80 participated in, and all completed the study. The sample comprised majority female (72%), between age 18 to 25 (74%), Anglo (73%), with 39% Junior and 24% Sophomore. Cronbach's alpha yielded .93 for the flow total, and .69 to .88 for the subscales. Descriptive statistics reported the highest score for the flow total scale: CD-ROM (low content, high presentation, M=119.70, SD=15.50), ERIC (high content, low presentation, M=114.15, SD=19.53), Internet (high content, high presentation, M=111.55, SD=18.36), and MS Word (low content, low presentation, M=105.50, SD=14.31). Normal distribution and homogeneity of variance held for all treatments. Pearson r was reported from .58 to .89 between the flow subscales and total scale.

The autoletic subscale detected significant main effect of presentation ($F_{(1,,76)}$=27.61, p<.03). Significant interaction effects were reported for the flow total ($F_{(1,,38)}$=9.07, p<.005), and subscales: challenge ($F_{(1,,38)}$=14.79, p<.0004), goal ($F_{(1,76)}$=9.36, p<.0031), feedback ($F_{(1,76)}$=7.75, p<.0068), awareness ($F_{(1,76)}$=11.41, p<.001), control ($F_{(1,76)}$=4.15, p<.04), and consciousness ($F_{(1,76)}$=5.23, p<.025). Simple main effect analyses reported participants using high presentation quality platform scored higher on the total ($F_{(1,38)}$=9.07, p<.005), challenge ($F_{(1,38)}$=14.79, p<.0004), goal ($F_{(1,38)}$=11.37, p<.002), feedback ($F_{(1,38)}$=5.39, p<.02), awareness ($F_{(1,38)}$=21.11, p<.0001) and consciousness ($F_{(1,38)}$=10.94, p<.002) subscales at the low content relevance activity, and but no significant presentation quality effect on flow and flow subscales at the high content relevance activity. It also reported participants in high content relevance activity scored higher on the challenge ($F_{(1,38)}$=6.56, p<.01), goal ($F_{(1,38)}$=5.78, p<.02) and feedback ($F_{(1,38)}$=5.72, p<.02) subscales while using the low presentation quality platform. However, participants in low content activity scored higher on the challenge ($F_{(1,38)}$=7.00, p<.01), awareness ($F_{(1,38)}$=21.73, p<.0001) and consciousness ($F_{(1,38)}$=11.90, p<.001) using high presentation quality platform.

Discussion

The study revealed strong interaction between content and presentation on flow experience. Presentation quality enhanced flow (d = .46), as measured by challenge, goal, feedback, awareness and consciousness in low content relevance activities. However, it did not have significant effect on flow in high content activities. Content relevance, on the other hand, enhanced flow experience (d = .36) while using low presentation quality platforms. However, it impeded flow experience (d = -.43) while using high presentation quality platforms.

Hypermedia is a double-edge sword for instruction. While not necessary increase learning, multimedia adds appeals to the instruction, motivate students and facilitate flow, as long as they are used appropriately. Multimedia should integrate gradually into a lesson. When the content relevance is high and adequate challenge is already provided, high presentation quality is distracting. As instructional designers, we must integrate multimedia into the lesson carefully, or it has negative consequences. Multimedia elements should be used sparsely in the beginning when challenges are high and students are unfamiliar with the material. The elements should be incorporated gradually as lesson progresses when challenges are reduced, at which multiple-channel stimuli will no longer impede performances.

However, multimedia can be an effective mean in alleviating boredom for expert students. An intrinsic problem in instructional design is its necessity to aim at an average or normative level. As Csikszentmihalyi (1982) noted, easy material makes schooling a bore for many students. For others, the difficulty of the material causes great anxiety. When the content relevance is low and inadequate challenge is provided to students, high presentation quality has a positive effect on motivation. Findings in this study suggested that instruction could be designed to present materials to expert students with more hypermedia elements. High quality presentation with advance technology can be employed to maintain students' motivation.

Autotelic or intrinsically rewarding experience is the most important dimension of flow and directly related to intrinsic motivation. Significant main effect of presentation in the autoletic subscale indicated that students preferred high presentation quality regardless of the content relevance of the activity. The richness of hypermedia increases motivation, despite its negative impact when the students' capacity is already stretched during high content relevance activities. Interestingly, the result indicates that students are not very effective in self-monitoring. The excessive stimuli during a high content relevance task impede flow. Nevertheless, students still prefer the multi-channel presentation, and are unable to realize its negative impacts.

This study is only a beginning step to the formulation of a prescriptive model for the motivational aspects of instructional design based upon the flow theory. There is absolutely no reason why the classroom cannot release as much excitement, energy and achievement as are seen in sport stadium and playing fields around the world every weekend. More researches and explorations in the motivational aspects of instructional design will help transform the classroom from a place where students "have to be", into a place where students actually "want to be".

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User Centred Courseware

Lorna Uden
School of Computing, Staffordshire University
The Octagon, Beaconside, Stafford ST18 0AD, England
l.uden@soc.staffs.ac.uk

Alan Dix
School of Computing, Staffordshire University
& aQtive limited, Birmingham, UK
alan@hiraeth.com

Abstract: User Centred Courseware Development (UCCD) offers an alternative approach to courseware design. Instead of the traditional approach involving only the designers, UCCD provides a learner-centred design approach. It offers a comprehensive alternative design process, involving different activities, practices and methodologies appropriate for the different phases of system development. This paper describes UCCD in the context of a case study involving the development of courseware for a high school in Stafford, UK (students aged 11-18). It shows how UCCD can be used to design effective and usable courseware which meets users requirements and expectations.

Introduction

In this paper we will give a brief review of User Centred Courseware Development (UCCD) a novel courseware development process building on principles of user centred design from human-computer interaction and information systems. We will start by giving a short overview of the background and structure of UCCD. The main part of the paper will look at UCCD in more detail as applied to a specific case study, the development of courseware about World War 1 for 13/14 year olds in a Stafford high school. This will be followed by a short analysis of the lessons learnt from this exercise and for user centred courseware design in general.

User Centred Design

Traditional courseware development is normally carried out by designers, who take complete control. It is rare that the end users (who include the teacher and learners) are involved. Although the courseware produced may be effective, it often lacks usability. User-centred design is an approach to integrate user requirements, user interface, validation and testing into a design process to make the software usable. Rather than being technology-driven, user-centred design focuses on the people, or users.

The benefits of adopting UCD to courseware design are that it accelerates software development and improves quality of life of users by reducing stress and improving satisfaction. This in turn improves user interface and system functionality, which improves the level of productivity of users with fewer errors. Overall the system is easier to understand and use, thus reducing training costs, and finally software maintenance in terms of support calls and documentation errors is dramatically decreased.

Methods for User Centred Design

There are several methods which are applicable to the development of user-centred courseware. Two of the well-known methods that have been used successfully in software development are Participatory Design (PD) and Joint Application Development (JAD) (Carmel 1993). There are several similarities between PD and JAD. Both methodologies stress a high degree of user involvement as imperative to good design of software systems. Both represent new thinking on the traditional forms of user involvement. Both involve the users in workshops and to various degrees, encourage creativity and new thinking. Practitioners in PD and JAD often employ simple, low-level documentation and visualisation methods in their workshops.

User Centred Courseware Development

We have developed a method known as User Control Centred Development (UCCD) which incorporates some of the principles of PD and JAD using prototyping. At a high level, major steps in developing a courseware application in UCCD include those shown in Figure 1.

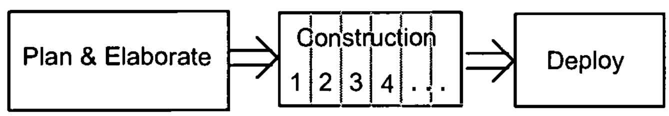

Figure 1. Macro-level steps in UCCD development process

The process is an iterative and incremental development process, in that the software is not released in one "big bang" at the end of the project. An iterative life-cycle is based on successive enlargement and refinement of an application through multiple development cycles of analysis, design, development, implementation and evaluating. The application grows by adding new functions within each development cycle.

The first phase of UCCD is the plan and elaborate phase. This phase includes the initial conception, investigation of alternatives, establishing the rationale of the project, planning, specification of requirements and so on. During this phase we also collect more detailed requirements, do high-level analysis and design to establish the baseline architecture and create a plan for construction. The construction phase consists of many iterations, in which each iteration builds production-quality courseware, tested and integrated, that satisfies a subset of the requirements of the project. Each iteration contains all the usual life cycle of analysis, design, development and evaluation. Each iteration or development tackles a relatively small set of requirements. The system grows incrementally as each cycle is completed. This is in contrast to the traditional courseware cycle in which each activity (analysis, design, and so on) is done for the entire set of system requirements. The advantages of using an iterative development process include the complexity is easier to manage because early feedback is generated, because implementation occurs rapidly for a small subset of the system. The last phase is the deployment of the application into actual use.

Case study: UCCD

The UCCD method is described in a case study concerned with the development of a courseware for students aged 13-14, learning history on World War I (1914 - 1918). The users involved are the history teacher and the students in her class. The subsequent sections of this paper document the UCCD process.

Plan and elaborate

The first session was scheduled with the teacher and students at the high school. As designers we believe strongly that correct and thorough requirements specifications are essential to a successful project. The primary goal of the requirements phase is to identify and document what is really needed in a form that clearly communicates to all participants. During our first meeting we conducted a conceptualisation process. Conceptualisation is the process of coming up with an idea for a system, along with a general idea of its requirements and form. It finishes the statement, "The system we want is ......". The primary output from this process is a set of core requirements for the system.

We started the conceptualisation process by conducting a use case analysis to identify the actors involved in the system. Use Case analysis was first popularised by Ivor Jacobson who defines a use case as a typical interaction that a user has with the system in order to achieve some goals (Jacobson 1994).

An *actor* is a role that a user plays with respect to the system. There are five actors identified for the school: headmaster, teacher, students, secretary and, of course, the computer systems itself. Actors carry out use cases. A single actor can perform many use cases. Conversely, a use case may have several actors performing it. Actors do not need to be human. An actor can also be an external system that needs some information from the current system. Figure 2 shows a Use Case Diagram for the high school in question.

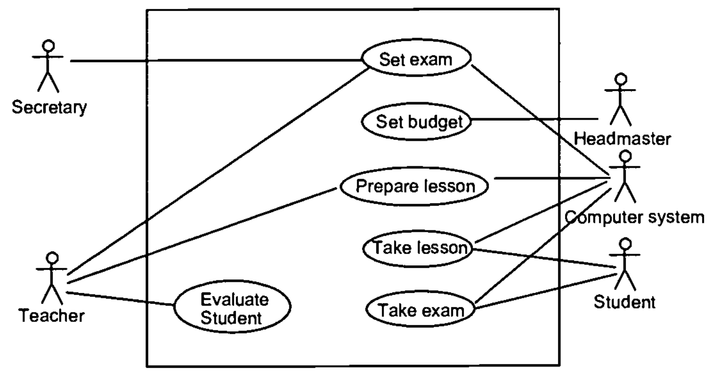

Figure 2. Use Case Diagram for the School.

Following the identification of the actors involved in the system, we, with the teacher, then tried to determine the requirements of the system. The goal identified following our conceptualisation process was "To develop a courseware for the students to learn the history of World War 1 using the computer." In order to improve our understanding of the requirements we created high-level use cases to quickly obtain some understanding of the overall major processes involved. Examples of the use cases identified include: (I) to describe the events leading to World War I; (ii) to show the timeline of World War I; (iii) to discuss the horror of wars; and (iv) to understand the implications of the use of machine guns in World War I.

A prototype was created, using storyboards, to verify the requirements based upon the use cases identified. The main purpose of the prototype at this stage was to aid understanding of the problem and establish requirements. The students and the teacher evaluated the prototype. The identification of use cases was probably the most critical part of the plan and elaborate phase. The main purpose was to determine the tasks the learners must perform to achieve the goals. An important result of the elaboration is that we have a baseline **architecture** for our system. The architecture consists of a list of use cases that tell us what the requirements are and the domain model that captures our understanding of the subject and serves as the starting point for our key topics.

The architecture is the foundation of our development. It acts as the blueprint for later stages. Included in this phase was the plan for the project. The essence of the plan is to set up a series of iterations for construction and to assign use cases to iterations. The plan is fulfilled when each use case is put into iteration and each iteration's start date has been identified. The use cases obtained are then categorised and the level of priority assigned to each use case. For each prioritised use case it is also necessary for us to estimate the length of time each use case will require. Another important analysis that is necessary is that of the learners. The purposes of analysing the learners are to determine the entry-level of the course and the relevant characteristics of the learners. It is also important to identify their intellectual abilities, language level, and learning styles.

Construction

The construction phase of a project involves a repeated development cycle or series of iterations within which the system is extended. The final objective is a working courseware application that correctly meets the requirements. Each iteration is a mini-project. We do analysis, design, development, evaluation and integration for the use cases assigned to each iteration. We finish the iteration with a demonstration to the users and perform evaluation to confirm that the use cases have been built correctly. The iterations with constructions are both incremental and iterative. The iterations are **incremental** in function. Each iteration builds on the use case developed in the previous iterations.

The development cycle

Development cycles are organised around use case requirements. The development cycle is assigned to implement one use case. The methodology chosen for the development cycle or iteration is the Uden Courseware Engineering Methodology (Uden 1997). UCEM is a courseware development methodology based on the construction of models from analysis to implementation. It provides a seamless transition from analysis to implementation, allowing a clean traceability between models. Both the teacher and the students were involved throughout each development cycle. Besides the teacher, about six students were chosen to be co-designers. For each iteration development at least three meetings were conducted. The first meeting normally only involved the teacher and ourselves. During this session we carried out the analysis and design phase of UCEM.

Analysis

Domain analysis is the most critical step in the courseware design process. The main purpose of the domain analysis is to determine the tasks or topics to be learned, i.e. what is worth teaching. The domain is gathered by interview and brainstorming sessions with the teacher on the history of World War I.

During domain analysis each of the high-level use cases identified during conceptualisation would be expanded to show more detail. From each of the use cases we produced a domain model based on the domain analysis carried out for each use case. The domain model illustrates meaningful concepts in a subject to be taught. The domain model is a representation of concepts in a subject matter. It can be illustrated with an object diagram showing the topics, and subtopics, their associations as well as their structures. An example of the domain model produced using an object diagram is shown in Figure 3.

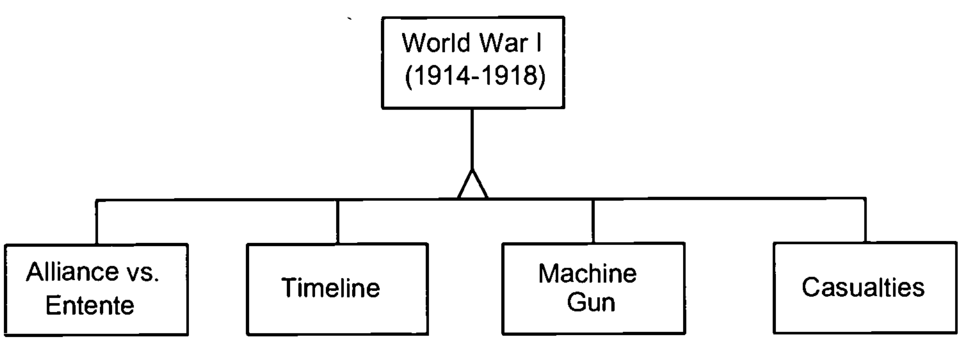

Figure 3. Domain model of world war 1.

Design

The design phase is concerned with the construction of the pedagogical model. It involves the identification of learning objectives and the design of assessment items and instructional strategies. The pedagogical design deals with the modelling of the instructional aspects of the courseware. The main objectives identified for the history lesson are to describe the events that led up to World War l; and to show the effects of these events.

To determine if the students have learned we must assess them. This involves designing tests. The tests designed must match the objectives stated earlier. According to Gagne (1965) there are different types of learning and each requires different learning strategies. Depending on the learning outcomes, we need to design the instructional strategies for the instruction. This completes the pedagogical model ready to be input for development.

Development

The development phase of UCEM was carried out by us, the designers. The pedagogical model produced must be transformed into software, which can be input to the computer. This is carried out in the development phase of UCEM. Development consists of three sub-processes: conceptual modelling, navigation modelling and interface modelling. During conceptual modelling the pedagogical model is translated into software. If hypermedia is used, the conceptual model is then transformed into the navigation model taking into account the design of the navigation structures. This is followed by the interface development for the courseware. The courseware with the complete development is then ready for implementation.

Evaluation

Evaluation is essential to make sure that the iterative development satisfied the requirements. Evaluation usually uncovers problems that may not have been noticed during development. The evaluation was carried out by students and the teacher. This happened during the second meeting of the development cycle. The developed courseware was given to the students to evaluate. The users, including the teacher, were encouraged to come up with suggestions for improvements. We stayed 'at a distance' in order to let the users themselves explore the prototype. There was no intervention or suggestions for improvements by us in the process, except in breakdown situations in which the users had problems. The groups which consisted of a dozen students worked enthusiastically with the prototype and came up with constructive suggestions for each session. All of the recommendations and suggestions by each user were recorded by us. Any unclear issues were taken up with the users to make sure they understood what was needed. No suggestion was considered too trivial. We wanted to make sure the users were happy and that felt they were part of the team. Users were happy to co-operate and valued the opportunity to be co-designers. The suggestions or recommendations were incorporated as we received feedback from the users. The revised courseware was then given to the students to be further evaluated. The development cycles continued until all the use cases were completely developed and integrated into the courseware.

Discussion and suggestions

Although the outcome of the project was a positive one, there were also many problems. This was particularly so when we came to the design of the pedagogical model. Being a subject expert herself, the teacher was only concerned about the content of the subject. It was very difficult for her to see the importance of objective definitions in the design. We are firm believers in having sound principles from instructional design theories incorporated in the courseware. Unfortunately this was rather alien to the teacher. Much time was spent in having to explain the concepts to her. Although she might not have had much knowledge of the processes involved, she did make considerable contributions in each of the activities and was very supportive. As World War I was not a subject with which we were particularly familiar, we had to learn fast in order to become competent. The teacher was very patient with us and taught us a lot. With hindsight, we could have better prepared ourselves.

Another problem, which often surfaced during the development, was that we often did not see things from the same perspective. There were ideas that we considered as essential and pedagogically sound which were not necessarily acceptable to the teacher. For example, for learning the timeline we suggested the drawing of bar charts should be used. This was rejected because students are not expected to do this in a history lesson. We found the teacher's insistence that this activity was the province of a Mathematics lesson quite disturbing, although this was not really the teacher's fault. Traditionally learning in school is concerned with particular content in discrete subject disciplines. A holistic approach is seldom encouraged, resulting in students passing examinations but not being able to apply knowledge in a wider context.

Finally, users who are not very conversant with technology often have higher expectations of what can be achieved. We found that, due mainly to media hype, they demanded more than we were able to provide. For example, they wanted video footage of World War I, which we were unable to obtain. On the positive side, the teacher found the co-designer process helpful and learned much about the importance of instructional design principles and appreciated their use. Because the teacher was part of the design team and thus had ownership of the problem, she was more willing to adapt to an unfamiliar teaching situation. The resulting synthesis of ideas led to a very usable product. For the students, they also experienced the ownership of the problem and took upon themselves the fact that it was their project too. This lead them to become more motivated in their learning of history. They found learning fun because they were creating their own learning materials and deciding what was good for them. The interactive nature of the computer with its powerful graphics facilities also fascinated them.

Lessons Learned

We learned many things from UCCD. Firstly, users rarely know what they want at the start of the project. As designers we must provide the scaffolding to guide them in identifying their learning objectives. Secondly, working with the prototype allows the users to get a better 'feel' for the proposed courseware lessons so that they could be more confident with the system to be built and be able to contribute constructively. Thirdly, when users saw what the prototype could do, their expectations changed and they wanted more features. It is important to set a realistic threshold on their requests. Fourthly, as users were part of the team, they were very keen to be involved and felt they 'owned' the problem. Fifthly, UCCD shows us the importance of designing for the users and their requirements. Sixthly, the process enables us to produce a system that is more tailored to the users' needs. Finally, for user-centred courseware design to work, it is important to have a graphical user interface tool such as Visual Basic, which allows us to produce a quick product.

Conclusion

To develop usable courseware is a difficult task. Typically, courseware development based on the expert approach does not always produce systems that meet users' requirements. For courseware to be usable it must be accepted by the users and meet their needs. This means that users must play an active role in the design and development process as co-designers. Designers and users must join forces together in the design. Because the users know best the context of their environments, they are able to overcome many of the problems that designers are not able to envisage. The user-centred design paradigm enables designers to produce courseware that will meet the users' needs. We have learned from our case study that Experts alone cannot design systems that will satisfy users. Only the users - in the context of their work or learning - can provide the necessary expertise for successful design.

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CILSE-GCE: A Collaborative Intelligent Learning Support Environment on World Wide Web

Feng-Hsu Wang
Department of Information Management
Ming Chuan University
Taipei, Taiwan, R.O.C.
fhwang@mcu.edu.tw

Ching-Hui Alice Chen
Department of Information Management
Ming Chuan University
Taipei, Taiwan, R.O.C.
achen@mcu.edu.tw

Abstract: Making intelligent learning supports available on World Wide Web (WWW) is a potential way to enhance a student's learning capability by integrating the flexibility and adaptability of intelligent supports with world-wide availability of WWW-based applications. In this paper we present the design and implementation of a collaborative intelligent learning support environment called CILSE-GCE for global climate exploration on WWW. The task domain is inherently a scientific classification problem, in which students are expected to induce climate classification rules and develop their own interpretations by making observations of a couple of climatic features. Based on a collaborative study-based learning model, we develop a set of tutoring strategies and implement the corresponding intelligent learning supports. As the classification task involves fuzzy climatic features, we develop an intelligent fuzzy tutor to evaluate and keep the student's exploration going toward target knowledge.

Introduction

This is a prosperous age in terms of rich learning theories, instructional designs and computer technologies. Their integrated efforts have made pervasive influences on the ways we teach and learn, and definitely have created great possibilities and chances to build an ideal learning environment, where students enjoy, share and appreciate the learning itself. In recent years, research and development of intelligent learning environments (Major & Reichgelt, 1992; Chan, 1994; Bell, Davis, & Linn, 1995; Edelson, Pea & Gomez, 1996) have been growing rapidly and widely. This paper demonstrates a project working toward this trend. In this project, advanced computer technologies, such as artificial intelligence, World Wide Web (WWW), Geographic Information System (GIS) and multimedia are integrated successfully with the collaborative constructivist learning theory (Black & McClintock, 1996; Honebein, 1996), resulting in a collaborative intelligent learning support environment on WWW.

This two-year project, beginning from mid 1998, aims to build a collaborative learning environment (named CILSE-GCE, Collaborative Intelligent Learning-Support Environment for Global Climate Exploration) that provides constructivist-inspired learning tools for open-ended inquiry as well as communication tools that support multi-learner collaboration. In this environment, students learn by exploring the global climate patterns, sharing their discoveries and producing the target knowledge collaboratively. Special attentions would be paid to the kinds of learning supports the system could provide for the student's exploration and collaboration processes. The ultimate goals of this project include investigating the collaborative constructivist learning model and instruction design principles, the development model of learning environments and system functionality, and the feasibility of applying artificial intelligence to support constructivist learning.

Based on the collaborative study-based learning model by Black & McClintock (1996), we develop a two-level group learning model suitable to be practiced in so-called *virtual classrooms*, and implement the corresponding teaching supports and communication utilities. Besides, as the classification task involves fuzzy climatic features, an intelligent fuzzy tutor is designed and implemented to evaluate and keep the student's exploration going toward target knowledge. It could also help students in the construction of climatic interpretation models as concept maps.

This learning environment is designed with the intention not only to teach students the target knowledge, but also the scientific ways of study and communication skills. We believe the students will achieve higher learning goals through the collaborative process of creating knowledge by themselves. These might include the ownership of knowledge, high-order thinking skills, and the potential of becoming a long-life learner. Preliminary formative evaluations have been performed during the late 1998 and early 1999, while a more complete evaluation is scheduled to be performed and investigated in the second year of this project. Hence in the following we will focus mainly on the design and implementation issues of the learning environment, and present some preliminary findings of the first year research.

The Collaborative Study Model

We adopt the perspective that the basis for cognition is interpretation based on background knowledge and beliefs (Winograd & Flores, 1986). Thus, the key consideration in our design is fostering the construction of interpretations based on observations and background contextual information. This learning process is often referred to study (Black & McClintock, 1996), in which students make observations, construct interpretations and arguments via access to background and contextual materials. All stages of the study can be performed collaboratively. Based on the aforementioned theory, we propose a two-level group study model suited for virtual classroom practicality, as shown in Fig. 1

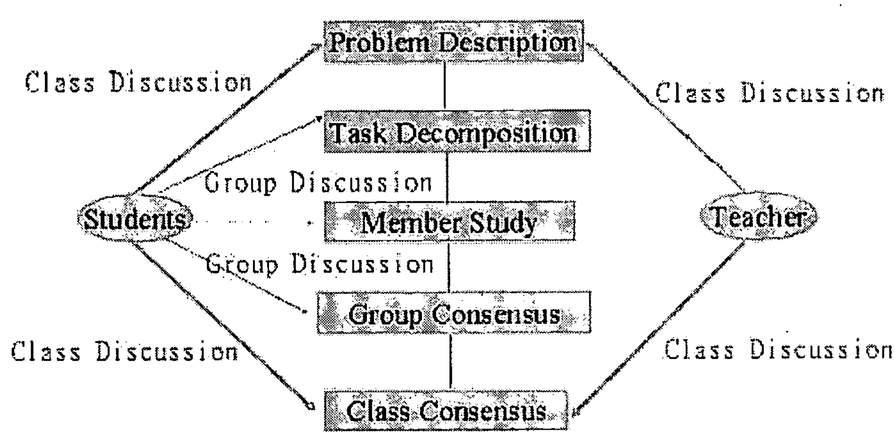

Figure 1: The two-level group study model.

In the two-level group study model, there are two forms of discussion. One is the *class discussion* and the other is the *group discussion*. Students are first pre-assigned to specific groups as they wish, except with the only constraint of group size of 5 to 6 (a variable that needs further investigation). The human teacher then announces the target problems to the student groups and coaches some basic problem-solving skills through the class discussion. Then the student groups commence the collaborative study process by first negotiating a proper decomposition of tasks. Each group member is assigned a specific learning task and starts to explore the problem in the learning environment, trying to work out the answers and put down the results in notebooks and concept maps. Each group then negotiates, defenses and integrates the member products to achieve group consensus and generate their final group product. Finally, the teacher and all students start to discuss, defense and evaluate all group products one by one to achieve class consensus. As a result, students could develop their social communication skills and learn to investigate problems from different perspectives as illustrated by the works of their colleagues.

The Global Climate Domain

The target domain draws sources from the instructional material in the geographic climate course of senior high schools in Taiwan. The contents consist of: (1) constituting attributes of climates, (2) influential attributes of climates and (3) twelve climate patterns on the earth. The constituting attributes include the atmosphere temperature, atmosphere pressure, wind system, and so on. The influential attributes encompass the degree of latitude, topography, distance from the sea, etc. Finally, the climate patterns include the tropical wet climate, temperate wet climate, and so forth. The domain knowledge could be interpreted in a two-level abstraction as shown in Fig. 2. The first knowledge level is about each climate pattern, which is recognized as a specific set of the climatic attributes. The second knowledge level is a deeper, causal knowledge that involves the influential attributes and their interactions, which comprise a scientific interpretation model that explains a terrain's climate.

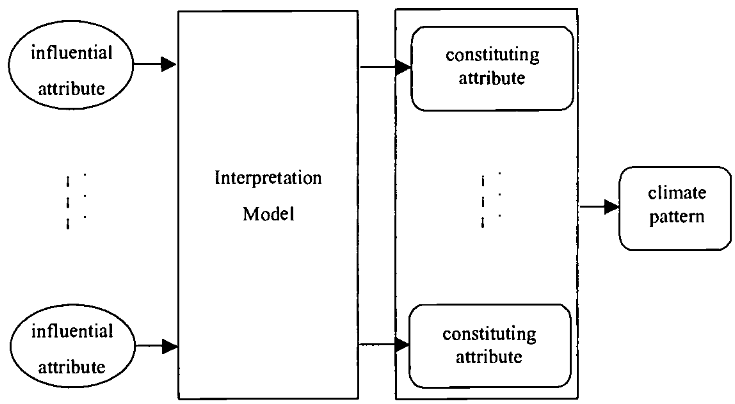

Figure 2: The knowledge structure of the climate patterns.

The task domain, global climate exploration, is inherently a scientific classification problem. In the member study phase of the group study model, each student is expected to induce classification rules by making observations of a couple of climatic features. A visualized information system based on the GIS technique is developed to help students make observations, data collections, comparisons and recordings about climatic features within and between any regions of the globe. The student could send his/her findings to a fuzzy tutor that evaluates the results and gives proper suggestions about the student's exploration process. Students are also required to construct an interpretation model of the climate patterns, explaining why and how the features interact to each other. The *concept map* (Jonassen, etal., 1997) is used as a mind tool for recording such kind of learning states. The concept maps along with the electronic notes serve as the basic contents for knowledge collaboration process.

The Learning Environment

Three components of the CILSE-GCE learning environment are presented in this section. They are the Virtual Classroom, Visualized Data Viewer, and Intelligent Fuzzy Tutor, respectively. The system architecture is shown in Fig. 3. To facilitate our further research, all learning activities of the students in this environment are logged and could be queried back later for more analysis. The Virtual Classroom serves as the origin where teachers and students coordinate and collaborate. Through the Virtual Classroom, students could access the multimedia course base, the climatic GIS database (via the Visualized Data Viewer) and the historical literature database. These rich data sources allow students to observe, search and collect related information in different aspects regarding to the problems at hand. Editing tools like the electronic note and the concept map editor are also provided to help students write down their discoveries and final works. All these personally created stuff are stored and managed by the system automatically, and if authorized, can be accessed by other students, thus enriching the system data resources in a multi-perspective manner.

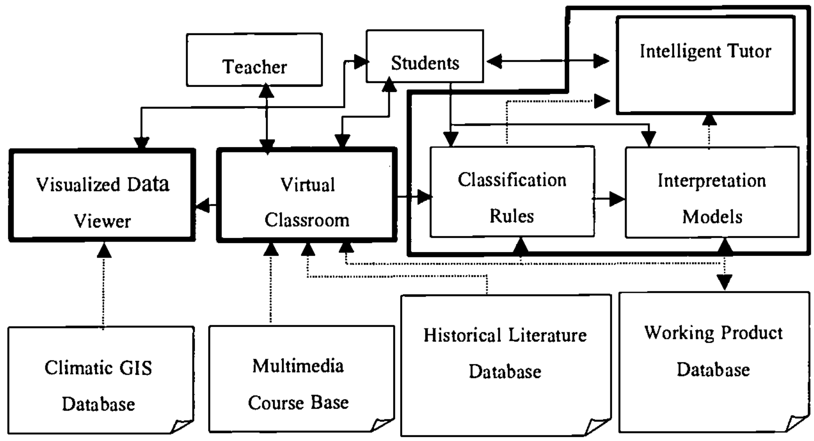

Figure 3: The system architecture of CILSE-GCE.

In the Visualized Data Viewer, the climate information could be displayed in different layers of maps covering the globe. Students could select, resize and combine different information layers for display to investigate the climate attributes in different perspectives. Hotlinks to climatic data and statistical graphs associated with the typical cities are also provided to allow students to do some measurements and inferences.

We design an intelligent fuzzy tutor to help students induce the classification rules, which are represented as a setting of the constituting attributes of the climate patterns. During the rule induction process, a student has to identify what the settings of the relevant attributes are by exploring resources of all kinds. When he/she determines a specific set of attribute values, the intelligent tutor would evaluate the student's answer, and give suggestions to guide the student's further exploration. As the classification task involves fuzzy climatic attributes, we develop an intelligent fuzzy evaluator to assess and keep the student's exploration going toward target knowledge.

When the student arrives at correct settings of the attributes, he/she is encouraged to construct an interpretation model that explains the causal relationship between the influential attributes and the constituting attributes. Students might query the material database to investigate the explanations of the various phenomena, and then deduce the causal model for the climate patterns. The intelligent tutor would check the models that students build, and give remedial hints if anything goes wrong.

Detailed Design Decisions

Learning Thoughtfully versus Learning by Memorization

In this section, we briefly summarize some design issues that were tackled for the CILSE-GCE learning environment. The first issue is to cope with the traditional problem of learning by memorization, a strategy adopted ubiquitously by Taiwanese students in geographic climate classes. Learning by memorizing facts empowers students for solving routine problems efficiently. However, it leads to inflexible use of the memorized knowledge in novel situations. On the other hand, learning to study things thoughtfully helps students to solve complex problems. Thus we provide a manipulable visual environment, in which students could engage themselves in the whole study process thoughtfully. In this visual environment students could observe real world data in different perspectives, derive their own classification rules and test the rules.

Whole Learning Tasks versus Component Skills

The second issue is about the argument of focusing on whole learning tasks or component skills. Having students perform whole tasks has the advantages of practicing the integrative skills that are necessary, and developing strategies suitable to the tasks as a whole. But it is difficult for students to focus on a particular weakness in the tasks. On the contrary, making students focus on sub-skills is sometimes very productive, but ideally this should occur when a weakness has been diagnosed. Our solution is to start by involving students in the whole induction tasks, and then to proceed to component tasks when appropriate. In this environment, students first visit the visual environment, considering the problem in all its aspects, and then develop and test their own classification rules. These rules could be assessed by an intelligent fuzzy tutor, which would identify the weakness in the student's exploration and provide some suggestions such as the important aspects that should be focused or the appropriate ways to investigate the climatic features.

Levels of Learning Supports

The third issue is related to the determination of levels of learning supports. Learning supports should be effective but not deprive the students of their learning opportunities. For example, the hints or suggestions given by the fuzzy tutor should not be so direct such that the answers can be derived straightforwardly. The scaffolding should also prevent students from answer-guessing activities. For example, an entry list for the student's answer should not be defined in advance, instead, it should be a freely-input entry. Besides, the evaluation feedback of student's induction results should not be just wrong or correct. It would be better, for example, to give some questions that require the students to think about another possibilities. Accordingly the environment allows students much more flexibility to explore.

For example, we design an intelligent agent to support the induction of climate classification rules. The student inputs the climate attribute values (i.e., a set of numerical ranges) and sends the answers to the tutor agent via the internet, and then the tutor receives and makes a fuzzy evaluation of the student's inputs. Finally, the tutor sends back the evaluation results, including suggestion messages, and the fuzzy degree of correctness of each climate attribute. The system also makes a log tracing the whole induction process of the student so that the studcnt could see and backtrack his/her induction process to a better position towards the target goal.

The Collaborative Study Process

The last issue is about the determination of the collaborative study processes. We develop a virtual classroom on WWW in which students study and work in groups. The human teacher first assigns problems to the students and coaches some basic problem solving skills. Then the student groups start the collaborative study process, working out the answers, and making defense within and between groups. We believe this collaborative process will foster all the constructive design principles mentioned in (Black & McClintock, 1996; Honebein, 1996), including observation, interpretation construction, contextualization, cognitive apprenticeship, collaboration, multiple interpretations and multiple manifestations, ownership of knowledge, self-awareness of construction process. Besides, our emphasis on classification induction problems is distinctive.

Conclusion

We adopt a form of iterative design to develop the CILSE-GCE environment. There is a strong connection between many of the design decisions taken and the results of formative evaluation. During the whole development process, we found that the most challenging task is to identify the information needs of the students. What material should be, and in what way, stored in the material database? Did we provide enough information and investigation tools for the students so that they could learn the greatest from this environment? These questions worth further investigation in our second year project. The answers to these questions are not only essential to this environment but also important to the research area of developing educational systems.

It is also indicated that during free exploration of a problem space, greater learning occurred if students adopted more systematic strategies for rule induction (Vollmeyer, Burns & Holyyoak, 1996). In our environment, students would experience the process of looking for patterns. However, students are different in the degree of systematicity with which they formulate and test their hypotheses. It is therefore important to provide instruction in the use of such strategies in order to allow maximum benefit from free exploration of the problem space. Further evaluation tests will be conducted to provide evidences of such kinds of learning. Another direction for future work would involve analyzing students' study strategies and examining their transfer performance in the consequence of problem solving.

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Designing an Open Architecture of

Agent-based Virtual Experiment Environment on WWW

Chi-Wei Huang, Chang-Kai Hsu, Maiga Chang and Jia-Sheng Heh
Department of Information and Computer Engineering, Chung Yuan Christian University
Chung Li, 32023, Taiwan, Tel: 886-3-4563171 ext. 4725
E-mail: jsheh@ice.cycu.edu.tw

Abstract: This paper proposes an open architecture of *virtual experiment environment* on WWW by using intelligent agent techniques. Several experiment components and a science experiment agent are analyzed and implemented to support teachers to quickly assemble a social learning system. Such design is based on distributed network architecture to attain high reliability and efficiency.
This architecture of agent-based experiment environment is composed of two major layers, *Coordinate Layer* and *Communication Layer*. And KQML (Knowledge Query and Manipulation Language) is used to realize communication protocols and information sharing language for the interactions among experimental equipment and science experiment agents. A workable experiment system based on our architecture, called *SoftLab*, is implemented on WWW to demonstrate its feasibility and flexibility.
Keywords: *virtual experiment, experimental equipment, WWW (World Wide Web), KQML (Knowledge Query and Manipulation Language), intelligent agent*

Introduction

In the last ten years, personal computers have sparked a revolution in education. Everyone from preschool children to senior citizens can now develop science projects and prepare reports by using computer technology at home. Besides being passive learning tools as textbooks, paper and pens, computer-aided education (CAE) systems can prompt learners some feedback and responses in appropriate ways during learning process. (Diessel 1992; Futtersack 1992; T.-W. Chan 1995) Take interactive tutorials for example, this kind of CAE systems can not only teach learners specific knowledge, but also evaluate what learners has been learned and re-teach based on the evaluation. Any paragraph in a course of study can certainly be reviewed to meet the needs of learners. (J.C. Gonzalez 1992; H. Lianjing 1992)

Considering the practicum of conventional education, "learning by doing" design brings the idea of situated learning into computer environment, as the interactions of human cognition are studied and improved in different computer-based learning environment. (Brown, Collins & Duguid, 1989) Hence, a simulated platform which provides learners experiment with visual equipment on computers, called *virtual experiment environment* (VEE) had been constructed on the computer network. (Y.-W. Jeng *et al.* 1996 J.C. Gonzalez *et al.* 1998) This paper proposes an open architecture of agent-based *virtual experiment environment* on WWW.

Section 2 identifies these problems when establish a *virtual experiment environment* on WWW. Besides several important issues are analyzed, an open architecture then can be constructed. After the open architecture is proposed, more detailed designing for a specific agent-based architecture are designed by Section 3. An experiment system constructed on WWW, is so-called *SoftLab*, providing a workable agent-based platform of physics in Section 4. Section 5 makes a summary and discusses those possible future works.

Architecture of Agent-Based Virtual Experiment Environment

The great advantages of WWW are information transmission and knowledge sharing. Unfortunately, those capabilities to support high quality interactive learning, retaining information of learners and even tracking the learning progress are still under disputed. Since an open architecture of agent-based *virtual experiment environment* on WWW is proposed, the idea of Software ICs (Integrated Circuits) should be taken into consideration.

Based on the precompiled binary code, *components* become independent of the language in which they were created. Furthermore, there are two more characteristics of components: reusability and flexibility. *Reusability* means that components can be used in many applications, continually enhancing and improving without having to recompile. On the other hand, the *flexibility* of components provides that suitable components can be simply chosen to extend the standard functionality for the specific needs.

Although the Software ICs are very useful for establishing such open architecture on WWW, there must have a container comprised several ICs and channels for exchanging data. It implies that if some experimental equipment used for experiments, an experiment environment must exist firstly. And than the experiment can be observed through those interactions in experiment environment. According to such viewpoints, a uniform interface among components is also necessarily provided by the open architecture.

Cooperative learning can improve both professional and social skills of learners, including face to different opinions and interdependence of group members. (Jamie C *et al.* 1998; Chanchai Singhanayok 1998; Doug L 1998) Therefore, the communication mechanism between participants of experiments has to design is also an important issue in order to achieve the goal of constructing synchronized and cooperative experiment environment.
As mentioned above, all issues are taken into consideration. The architecture of agent-based virtual experiment is then constructed as (Fig. 1) shown.

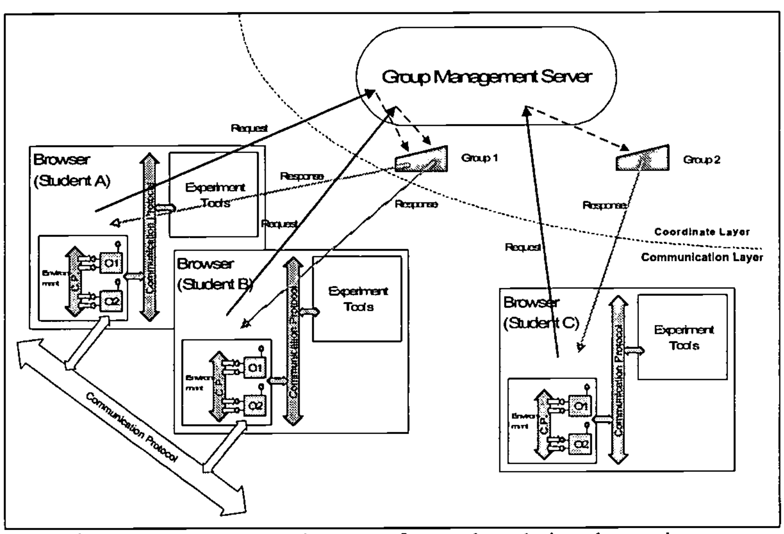

Figure 1. An open architecture of agent-based virtual experiment

(Fig. 1) indicates the architecture is composed of two major layers, Coordinate Layer and Communication Layer. Because distance learners may use browsers to participate in the collaborative online activities, the responsibility of *Coordinate Layer* is to deal with the cooperative learning when experiment in the virtual environment through the computer networks. And learners can work together for accomplishing a common task or experiment through the agency of *Coordinate Layer*.

Besides these interactions among participants, interactions among components in the *virtual experiment environment* have to handle. To describe and maintain this sort of relations between the equipment, such like ball and slope in the experiment, a management manner as *Communication Layer* provides is necessary.

Generally speaking, there are some standard physics laws illustrating the relationships between equipment (or simulated objects) in the environment to regulate the interactions. Two-ball collision is a good example for explaining. The key point is that balls never know they have a collision with the other one. They only know that if they are forced, then they must response an action corresponding to the excitation. So the environment must provide a mechanism to coordinate the behaviors of the objects and transfer the responses appropriately.

Although an open architecture with agent-based virtual experiment on WWW is constructed in this section, more detailed designs still need be done before this architecture can really open for educational purposes. After the *Communication Layer* is well designed, either learner to cooperatively /competitively learn with learners or teacher to teach/evaluate/answer learners will be replaced by intelligent agents (IAs).

Designing the Virtual Experiment Environment

Besides the utilization of component technology, more important issue which makes the architecture constructed in the previous section becomes open is a graph model for representing the relationships between experimental equipment. The detailed explanation for the graph representation is in the following.

Actually, experimental equipment in VEE must be embedded in such an experiment board in the environment so that these interactive relations between experimental equipment can be generated based on the interaction principles. There is three-stage mechanism in the experiment board to make the interactions between experimental equipment come true. At first, the relations between experimental equipment are described, and a directed graph is adopted to describe the experiment and store it in the form of adjacency-list. Secondly, the standard physics laws are pre-stored in the experiment board. It means each node in the adjacency-list will be searched, and a mapping from experimental equipment into the desired physics laws. The last stage implements the experiment based on the standard physics laws and those data structure produced in the second stage.

The relations between experimental equipment are described as a *directed graph* $G(V, E)$, where V is a finite set and E is a binary relation on V. The *vertex set* V of G contains all the *experiment equipment vertices* in this experiment; whereas, the *edge set* E of G stores all the *relation between the equipment.* (Fig. 2a) represents an example directed graph G of vertex set $\{1, 2, 3, 4\}$. If (u, v) is an edge in graph G, then the equipment u will interact with equipment v. An adjacency-list of (Fig. 2b) stores the relations between the equipment vertices in (Fig. 2a).

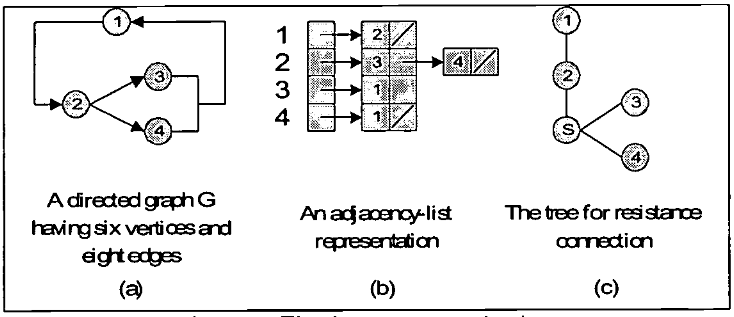

Figure 2. The three-stage mechanism

Take electric resistance connections for example to illustrate the above three-stage mechanism. The electric experimental equipment in (Fig. 3) is added as battery, resistance 1, 2 and 3. From (Fig. 2a) the representation of experiment after transformed into graph is shown in (Fig. 3), which means graph G has four vertices: V_1-Battery, V_2-Resistance 1, V_3-Resistance 2, V_4-Resistance 3, and five edges: (V_1, V_2), (V_2, V_3), (V_2, V_4), (V_3, V_1), (V_4, V_1).

After the first stage, the experimental graph then will be stored in the form of adjacency-list as (Fig. 2b) shown. Finally, a specific tree is generated from the adjacency-list based on the standard physics laws just like (Fig. 2c) shown. Accordingly, all the physics quantities in the electric circuit of this experiment can then be obtained.

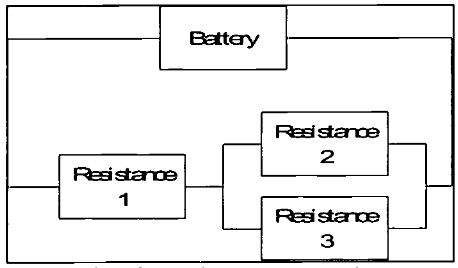

Figure 3. Electrics resistance connections example

Regarding the agent-based issue, intelligent agent's behaviors for the educational proposes should be analyzed first. Three behaviors can be simply told out as follows:
1) Online recording,
2) Online replaying,
3) Online navigating.
In most cooperative learning systems, it is necessary to design a communication protocol for information and knowledge exchange. In the open architecture of *agent-based virtual experiment environment*, the most useful agent communication language, *Knowledge Query and Manipulation Language* (KQML), is chosen as our communication protocol in *Communication Layer*.

KQML focuses on an extensible set of performatives, which define the permissible operations that agents may attempt on each other's knowledge and goal stores. The performatives comprise a substrate on which to develop higher-level models of inter-agent interaction such as Contract Nets and Negotiation. (Tim Finin 1992)

Conceptually, a KQML message consists of a performative, its associated arguments which include the real content of the message, and a set of optional arguments which describe the content in a manner which is independent of the syntax of the content language. For example, a login to a group learning system might be encoded as:

(*tell* :*content* (Login (Ken (jk1234y, user)))
:*language* list
:*ontology* Group-Learning)

In this message, the KQML performative is *tell*, the *content* is (Login (Ken (jk1234y, user))) and the assumed *ontology* is identified by the token :Group-Learning.

Implementing the Virtual Experiment Environment on WWW

(Fig. 4) in the following depicts the architecture for electricity, only with minor differences from the original one. An experiment system of physics course then is implemented under the open architecture proposed, called *SoftLab*. Besides these synchronous and asynchronous tools for Web-based learning, an intelligent science experiment agent, called *Lancelot*, is also added in *SoftLab*. The specific science experiment agent owns its architecture just like (Fig. 5) indicates. Distance learners are allowed to participate in those collaborative on-line activities through browsers. And with the characteristics of Web technology, it even can increase students' awareness of related concepts through the inclusion of hypertext links to other Web-based information. Chat-room is the only component that can be used by learners to communicate with others in VEE. Teacher, moreover, can also use it to give hints and comments.

Considering the benefits of component-oriented analysis, Microsoft ActiveX is chosen to implement the experiment system described above. It is easy to divide the whole system into components with abstract models of abilities and behaviors. Each learning work is implemented as an independent component. Owing to ActiveX technology, Microsoft Internet Explorer is chosen as the platform of VEE. And Visual Basic Script is then the bridge between components.

When designing the experiment system, performance issue of the system is the most important. The traditional BBS (Bulletin Board System) server is analyzed and modified in order to solve this problem. The major modification objectives include discussion board, flow control of learning, privilege management and group management. There are three parts in the whole *SoftLab*, including VEE, experiment tools and the science experiment agent Lancelot, as (Fig. 6) shown.

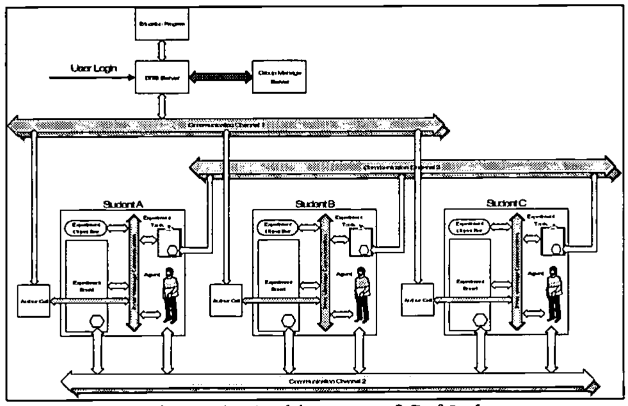

Figure 4. Architecture of *SoftLab*

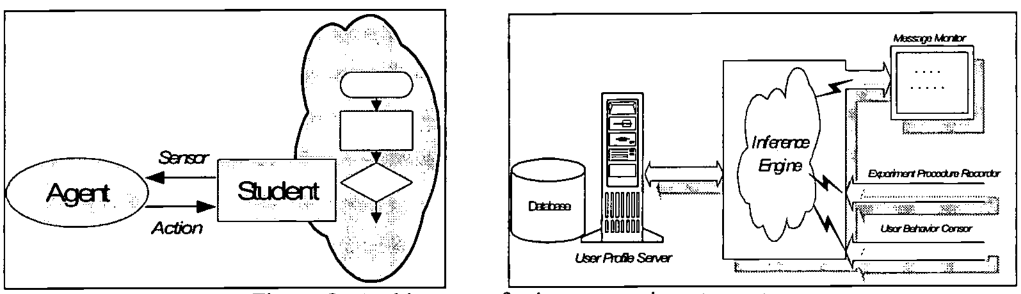

Figure 5. Architecture of science experiment agent

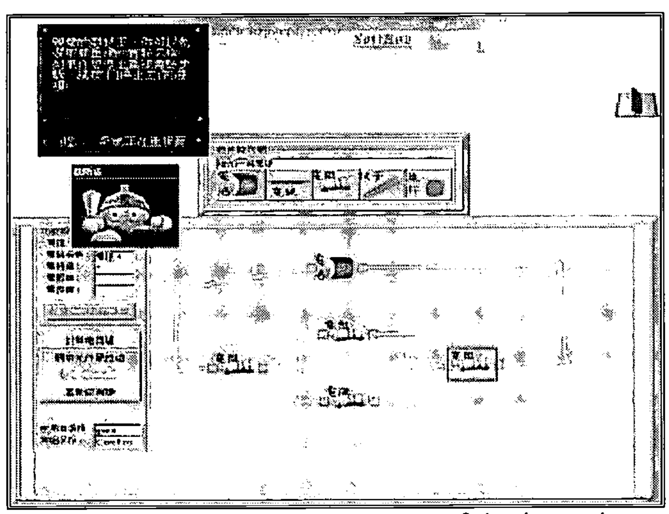
Figure 6. *Virtual experiment environment* of circuit experiment

Conclusion

In this paper, the possibility of constructing an open architecture of agent-based VEE on WWW is fully discussed and analyzed. Two major layers compose the architecture of agent-based experiment environment that are *Coordinate Layer* and *Communication Layer*. And the interactions between *experimental equipment* are realized by KQML. *SoftLab* is a workable experiment system implemented on WWW based on the architecture proposed in this paper to demonstrate the feasibility and flexibility.

Another interested research direction is the courseware and visual components design when an interactive user interface is used. As mentioned in the introduction, we believe that only those learning workspace systems designed with open architecture, such as VEE, can be extended easily. Furthermore, an intelligent agent system approach, such as the mechanism of knowledge formation during learning, might be analyzed deeply. In the agent-based VEE, learners can process a *virtual experiment* with agent cooperatively/competitively. Hence, how to evaluate the learning progress of learners is also a good research topic.

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Tele-Training on the Job
Experiments and Experiences in Media Integration

Sabine Payr
Forschungsgesellschaft Informatik (Research Center Information Technology), Austria
s.payr@fgi.at

Abstract:
The as.fit course has been developed for training office employees of SMEs in the use of advanced ICTs for telecooperation and e-commerce. It is delivered via tele-training to the workplaces of the participants, using a combination of online and offline media. The research work accompanying this course focuses on the question of how to define the adequate mixture of media in tele-learning and how to integrate them into a learning environment for effective training on the job.

1 The *as.fit* Course

Small and medium sized enterprises (SMEs) today face the challenge of adapting to the new conditions of doing business in the Information Society (see Alpar 1998, Reichwald 1997). The changes that cut deep into the organisation of the company can be characterized by acceleration, globalization and virtualization. The basic question for SMEs is: how can they manage change actively so as to be among the „Information Society winners"?

One of the preconditions for profiting from new opportunities is to master the new information and communication technologies (ICT) and the implications of their use. By „mastering" we do not mean their simple operation, but the skills and qualifications that are necessary to integrate them into the enterprise and to create management structures that allow for rapid change and flexibility.

With the project *as.fit diploma* we offer building blocks of these qualifications. *as.fit* (Advanced Skills for Information Technology and Telecooperation) is a tele-training course for administrative workers in SMEs. The principles of this training are

- embedding training into the company: involvement of management, contents that fit participants' needs
- tele-learning on the job: use of different technologies for interacting intensely with the student
- embedding learning into practice: problem-oriented tasks and activities; unity of tools for learning and working.
- The learners whom we address with our training are administrative workers (primarily secretaries or office managers) of SMEs. We consider the administration of an SME to be the future nerve centre of information management in a company. We involve the company with preliminary investigation and interviews and with accompanying consultancy and support.

With its contents, the course centers on today's practical needs of companies on their first steps into telecooperation, e.g.

- How to communicate efficiently via e-mail
- The legal aspects of doing business via the Internet
- The use of the Internet for efficient information retrieval and processing
- Which Internet services are appropriate and effective for the marketing of the company's products
- The role and purpose of the company's website, and consequently its design and contents.

- The choice of adequate communication technologies for the company's internal, business-to-business and external communication needs (e-mail, video-conferencing, mailing lists, newsgroups, chat, interactive web pages etc.)

These issues are treated in ten modules, varying in length from one to three weeks. The duration of the complete course is 20 weeks. It contains only three face-to-face stages – at the beginning, in the middle, and at the end, respectively. This shows that the course relies heavily on tele-learning.

2 Pedagogical Setting

2.1 Motivation for tele-learning

The pedagogical setting we chose for this course is tele-learning in a combination of communication media and self-paced study. By tele-learning we here mean distance learning supported by electronic media, or - the other way round - „the application of telematics for learning-related purposes" (Collis & Fisser 1998).

The main motivation for delivering this course via tele-learning is to take training to where it is immediately useful. This has always been the aim of „training on the job", e.g. in models of apprenticeship. In the ideal case, learning and practising merge imperceptibly. This ideal case, however, demands constant presence of a trainer and training for individuals or very small groups. Tele-learning can recreate some elements of training-on-the-job for larger and dispersed learning groups. This requires intensive communication with various tools and individualized coaching of the learner in the transfer from training to practice (Baumgartner & Payr 1998).

2.2 Technologies used

The range of technologies and media that we use in the course is broad:

- *Video-conferencing:* students' and trainers' PCs are equipped with desktop video systems connected via ISDN lines that are also used for telephony and Internet access. The result is not high-quality image and sound, but experiences (Wiendieck et al. 1996) have shown that the quality is sufficient to create a „presence". On the other hand, the technology we use is the same that can and will be used in the very near future in any office for communicating via video. The conference is switched via the multipoint control unit of a telecom operator (Post & Telekom Austria PTA). Video-conferencing is used for short lectures to the whole group of students (up to 20 persons), but also for individual communication between students and the trainer, or among students. The working groups that students form to work on given tasks or projects will also use video-conferencing at times, with and without the trainer.
- *Web server and web-based groupware:* The material for self-paced study itself is delivered in printed form (textbook) and on CD-ROM (interactive courseware). However, materials created during the course - by the trainer (resumes, feedback, additional explications, task sheets etc.) and by the students (feedback, results, solutions, questions, criticism, etc.) - are made available on the web. For this purpose, we use a simple groupware system (GMD's BSCW = Basic Support for Collaborative Work) with the typical basic functions of groupware: shared and versioned documents, closed user group, and a discussion forum.
- *E-mail and mailing lists* come in as those media that allow „pushing" information instead of the „pull" principle of the web. With these tools, we can make sure to reach the students immediately, and vice versa.
- *Chats* complement video-conferencing as another synchronous communication tool. Chats are used mainly in groupwork.

The following table (table 1) lists the technologies used in *as.fit* by the characteristics of communication:

Communication	synchronous	asynchronous
1:1	phone, video-telephony, chat	e-mail
1:n	video-conferencing	mailing list
n:n	video-conferencing, chat	discussion forum

Table 1: Communication channels and media used in as.fit

2.3 The Training Scenario

The basic „unit" of the course is the weekly lesson centered around a specific issue. The lesson is introduced in a short video-conference with all participants, where the contents and tasks of the week are presented. During the following two working days, students work on the subject using their textbook and, where available, the interactive courseware developed specifically for the course and distributed on CD-ROM. Task sheets and questionnaires for individual work can be downloaded from the groupware server. Questions and requests for help and clarification can be sent in via e-mail (to the trainers only) or circulated via the mailing list (for the attention of all participants).

The second general video-conference, halfway through the week (and the lesson) gives answers and additional information on the questions and issues raised by the students. By that time, the first part of the week's tasks have already been done and sent in, so that a preliminary overview of the students' progress is available. The second video-conference also sets out the second part of the week's workload. The final video-conference coincides with the first one of the following lesson: the results of the lesson are resumed and commented, before the course goes on to new contents.

Work in small groups (three to five students) plays an important role. It takes place with and without the trainers' participation. Most of the tasks contain elements of cooperation or at least the request to exchange and discuss results. Students use the same technologies for their work in group as for communication in the big group, in particular e-mail, chat, and video-conferencing. Each student has to take her turn in leading and animating groupwork, e.g. by setting up a video-conference, requesting contributions, editing final texts that have been written collaboratively.

3 The Challenge of Media Integration

3.1 Self-paced vs. scheduled training

The use of both self-study materials with asynchronous communication (distance learning model) and scheduled video-conferences and synchronous chats (course model) is at once a challenge and a necessity.

Most participants are not familiar with distance learning and don't possess the required „learning skills". Together with a setting where learning takes place at the workplace, during working hours, the risk of students who drop out because they can't manage their schedule is particularly high. So we combine this method of learning with scheduled sessions and, especially at the beginning of the course, with a relatively rigid weekly plan for responding, sending in work results, etc.

On the other hand, the rather short periods of time dedicated to self-paced activities require an almost constant presence of the trainer team, because the tight schedule does not allow for long delays between requests from students and replies from the trainer. In this respect, the course has indeed aspects of „training-on-the-job".

3.2 Tools for training vs. tools for work

The intensive use of different communication technologies that we require from the students serves two purposes: one is, obviously, to allow for intensive trainer-trainee-interaction. The other is to put the contents of the course to immediate use. The tools that are used for learning are the same that the participants learn to use for doing their job efficiently. They are thus encouraged to practise immediately what they have learned. At the end of the course, they are experienced users of a wide range of Internet services and of video-conferencing and can support the implementation of new communication and e-commerce practices in their company.

The seamless transition from learning tools to working tools is taken into consideration in the choice of software tools for the delivery of the course. For example, we refrained from using dedicated tele-training systems that combine e.g. video-conferencing classroom tools with groupware and discussion functions. We use instead nothing but the software that is installed together with the desktop video system, separate mailing lists, Internet chat, and a separate web-based groupware system.

3.3 Classroom vs. group vs. individual training

The first generation of tele-training via video-conferencing appears today like the revival of the „good old classroom teaching" with the addition of a new technology. The reason for this was partly the special equipment that was needed – or considered to be needed – for video-conferencing, i.e. TV-studios or studio equipment with several cameras, professional sound engineering, and the like. The other part of the reason have been and still are educational traditions, where the first thing that came to mind as the use for video-conferencing was the classical „lecture" that could be followed simultaneously on-site and at one or two remote sites.

Only gradually it became clear that the new technology both requires and enables new methods of teaching. Video and sound quality in themselves are not what tele-training aims at, but a new quality of remote social learning. Video-conferencing is an educational tool that has to be available to both trainers and trainees to establish virtual learning communities. Students in the *as.fit* course are therefore encouraged to use video-conferencing not only to participate in the „classroom" sessions, but also and even more to establish individual contacts among the student group and to collaborate on their coursework.

3.4 Online communication vs. offline courseware

It is clear that even in a tele-training course that relies heavily on synchronous and asynchronous communication technologies like this one, individual study still takes up most of the participants' study time. The „bulk" of the subject matter to be dealt with is therefore delivered quite traditionally on paper. In our case, there is no added value in using e.g. the Web for delivering text material. In this reasoning, we follow a simple principle: use each medium for what it is best for. And paper is still the best medium to read from, in a situation where none of the advantages of web-based texts supersedes – e.g. making texts available to anonymous readers at unspecified locations and times.

We also use courseware that we have developed specifically for this training measure. While a non-negligeable part of the development effort went into this courseware, its place in the range of educational media is again restricted to a specific role that cannot be fulfilled by other media: each courseware module presents a problem that students are confronted with in their daily work, e.g. how to deal with an order that comes in via e-mail, or how to search the Internet efficiently, how to organise the findings and make them available. The courseware thus offers the „missing link" between the factual knowledge in the textbook and the practice that students acquire by using the „real" software tools for their coursework and their daily work.

The method of learning that the courseware focuses on is problem-solving and decision-making (cf. Baumgartner & Payr 1994). In each situation, the student is offered several choices for solving it. Different alternatives can be followed and can lead to a solution – as in real life, there need not be exactly one „right“ answer or procedure. The cognitive map of each module is therefore represented dynamically by a complex graph.

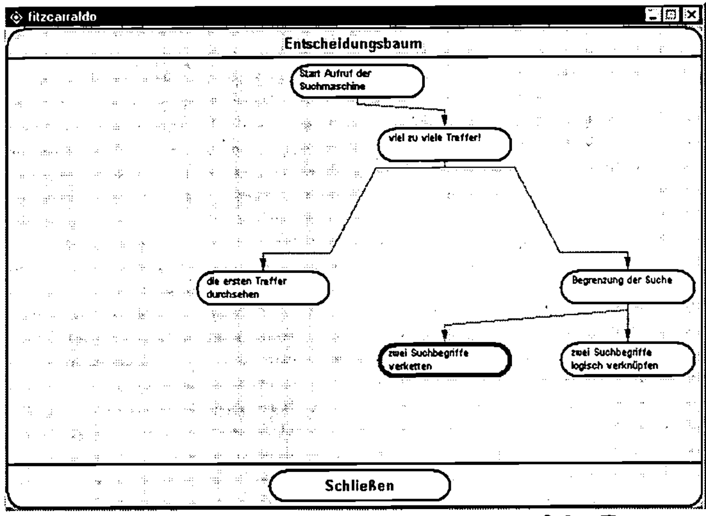

Figure 1: Dynamic decision tree as clickable cognitive map of the Fitzcarraldo courseware

Each node of this graph consists of a graphical representation of the contents (currently a screen, document, or drawing – but also images and video clips are possible) on which the two actors, a „trainer“ and a „trainee“ discuss, offer comments, questions and answers.

4 Questions for Research

From the point of view of research, we set up a „real-life experiment“ with this tele-learning setting. Most projects of this kind have to deliver „real“ and possibly efficient tele-training without a pre-existing basis of acquired knowledge and rules on how to develop and use the different media that are available today. So we cannot speak of a classical experiment where the various parameters can be changed at will and where failure is allowed as a valuable source of knowledge. We are rather in the domain of design, where modification and adaptation are possible underway, but where the basic hypotheses have been set in advance.

4.1 Finding the right „media mix“

The main research question is: what is the most appropriate combination of media in this setting for tele-learning? How much communication, scheduling, individual coaching and tele-cooperation is necessary, sufficient and desirable for creating a remote social learning environment that supports learning efficiently? What are the preconditions for successful tele-learning? What is the adequate „mix“ of online and offline, of synchronous and asynchronous, textual and visual media? The aim is to offer a model for tele-training that can be applied to other contents, target groups and social settings.

4.2 Methods

Progress of the students is continuously monitored through the coursework they have to send in, the requests for support they submit, their communication activities with the trainer team and with other students. Texts (e-mails, contributions to lists and chats, etc.) as well as video-tapings of the conferencing sessions are analysed using qualitative methods, drawn mainly from discourse and conversational analysis (Schmitt 1997, Weinig 1996). With these methods, we expect to gain insights into

- the specific nature of remote didactic interaction
- the conditions for successful training via video-conferencing
- the conditions for successful learning on the job
- the conditions for the viability of virtual learning communities
- the appropriate combination of educational media in different tele-learning settings

At the time of this Conference, a pilot course will have been completed and analysed. Two regular courses are under way at different stages, modified and adapted according to results from the pilot phase. The presentation therefore focusses on the latest experiences and empirical results.

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Turning Learning Environments into Learning Communities: Expanding the Notion of Interaction in Multimedia

Richard A. Schwier, Ed.D.
Educational Communications and Technology
University of Saskatchewan
Canada
Email: richard.schwier@usask.ca

Abstract: Emerging approaches to developing rich learning environments combine multimedia, computer mediated communication, and a host of interactive strategies to connect people in varied and robust ways. But traditional understandings of learning environments and interaction usually stop short of the kind of engagement that will allow learning communities to form. This paper examines theoretical and practical issues around promoting the growth of virtual learning communities. It considers issues surrounding virtual learning communities that can emerge using communication technologies in formal and informal learning environments.

The metaphor of community has been used to describe a wide range of contexts, from communities of practice in the corporate world (Brown & Isaacs, 1995; Wenger, 1998) to virtual community networks (Brook & Boal, 1995; Horn, 1997; Rheingold, 1993; Schuler, 1996). Given the right circumstances, any of the range of communities can act as learning communities, typically when they engage purposefully in the acquisition, transformation or creation of knowledge. But these entities do not focus exclusively on learning. For example, a community of practice may give much of its energy to identifying tacit knowledge in a corporate setting and making the tacit knowledge explicit for the good of the company (Wenger, 1998). Similarly, virtual or online communities may devote their resources to connecting people in new ways, and the substance of the connections may include anything from sharing information to building interpersonal relationships (Cohill, 1997), but they may exclude learning entirely.

Regardless of their focus, little is known about how people in virtual environments are influenced by those environments. We glibly suppose that people who are connected electronically are enriching their interpersonal network of relationships, whereas some emerging research suggests that electronic saturation may actually contribute to a sense of isolation among participants (Kraut, Paterson, Lundmark, Kiesler, Mukophadhyay, & Scherlia, in press). Social critics of technology voice concerns that the values and strengths of communities are undermined by the very technology that promotes new ways of interacting with others (Ehrenfeld, 1996; Selznik, 1996). With equal force, critics of distance learning suggest that technology-based courses emphasize transmission of information and isolate learners by placing technological barriers between learners and real people (Farrow, 1999).

In this paper I will argue that what may be most restricting about electronic types of learning environments is that they fail to promote a sense of community, that they remain interactive, yet fall short of becoming communities of learners. When technology is introduced to learning communities, there is a risk of promoting interaction without the concomitant elements required to turn a virtual learning environment into a virtual learning community, and this paper will explore what those elements are.

A Definition of Virtual Learning Community

Drawing on the definition by Kowch and Schwier (1997), communities are collections of individuals who are bound together for some reason, so a learning community emerges when people are drawn together to learn. A learning community is a group of individuals engaged intentionally and collectively in the transaction, or transformation of knowledge. Although learning communities emphasize outcomes in education, their power resides in their ability to take advantage of, and in some cases invent a process for exchanging ideas and learning collectively. Virtual learning communities happen when the process of learning takes place outside the boundaries of face to face contact, typically electronically. For the purpose of this paper, I want to use the broadest possible notion of learning. Learning as discussed here may include anything from formal education to very informal forums of exchange—any context that people can use to learn something of benefit to them.

A virtual learning community usually depends on the participation of relatively autonomous, independent individuals who are mutually engaged in the learning process. Outside mandatory attendance in some school settings, participants can not only leave the community, they can sometimes participate in the community without revealing who they are to the other participants. Autonomy and independence present difficult challenges for educators who want to build and maintain a learning community.

Growing Virtual Learning Communities

How does one begin a virtual learning community? First, we need to realize that building a community is not an organizational engineering problem — the problem is one of motivating participants to create a community and giving them an opportunity to do it. Clark (1998) uses the apt term "growing" in place of "building" or "constructing" to emphasize the organic nature of doing this kind of work. Ultimately, communities are built or dismantled by those in the communities, not by the people organizing or managing them. It is therefore a matter of providing an appropriate structure and sufficient support — the conditions for a community to develop. Some of these conditions include:

- A leader or leaders. The leader sets the agenda and the tone for the virtual learning community, and is the person known to all of the members of the community as the touchstone for protocol and administrative issues
- Transparent support technologies (Norman, 1998). Transparent technologies allow participants to concentrate on the tasks, relationships and ideas at hand. Extensive usability testing (see Nielsen, 1994) should be implemented at each stage of development to with the explicit goal of increasing the transparency of the interface.
- A safe and open mixture of interpersonal contact. People need to feel comfortable to participate, and unless the invitation to participate is explicit, and the boundaries of acceptable behavior are shared and understood, people will not be as likely to take risks in their communication with other members of the community. It is reasonable to publish written codes of conduct to keep communities on track (Bruckman, 1996).
- Liberal use of narrative. Clark (1998) makes a persuasive case for the use of narrative in virtual learning communities. He argues that because virtual communities are worlds of words, then the stories we tell are a powerful and appropriate vehicle of expression.

Elements of Community

Selznick (1996) identified seven elements of community--features that must be present to give an entity the label of community. Selznick's elements underscore the idea that communities are complex. Any adequate description of virtual learning communities needs to address these elements, and recognize that they are variables that interact multidimensionally. A successful community, actual or virtual, will exhibit a balance of these elements.

- **Historicity**. Communities are stronger when they share history and culture. Conversely, they are weak when they are based on general interests and abstract ideas.
- **Identity**. Communities foster a sense of shared identity. Successful virtual learning communities need to have boundaries—an identity or recognized focus.
- **Mutuality**. Communities spring from, and are maintained by interdependence and reciprocity. Participants construct purposes, intentions and the protocol for interaction.
- **Plurality**. Communities draw much of their vitality from "intermediate associations" such as families, churches, and other peripheral groups.
- **Autonomy**. Within the emphasis on group identity, it is important that communities respect and protect individual identity.
- **Participation**. Social participation in the community, especially participation that promotes self-determination supports autonomy and sustains the community.

- **Integration**. All of the above elements depend on supportive norms, beliefs and practices.

It is probably apparent from this list that these elements are not realized by chance. Communities do not just happen. But neither are they created. What we are attempting to do as educators is promote the development of virtual learning communities by nurturing the conditions under which they can arise. A sampling of ideas for promoting virtual learning communities is presented in Table 1.

Element	Implications for Virtual Learning Communities
Historicity	Incorporate what members have done in the past, and make their stories part of the community culture. Explicit mention of the culture, value and context of the virtual community. Make public the history of the community.
Identity	Use team-building exercises, develop community logos, and publicly acknowledge accomplishments by the group and individual members within the community. Articulate the focus or purpose of the community, and outline the requirements and rituals accompanying membership in the community.
Mutuality	Include group exercises, assignments, activities that require each member to contribute to the final product. Ask leading questions that encourage members of the community to invest in concerns held by other members, and to share ideas and possible solutions.
Plurality	Encourage membership and participation from and association with groups related to the learning focus. These might include businesses, professional associations, or groups in other countries exploring similar issues.
Autonomy	Foster individual expression and comment explicitly on its value. Set up protocol for respectful communication and reach consensus in the group. Create strategies for settling disputes or inappropriate behavior.
Participation	Allow members of the group to shape learning agendas. Give guidance to new community members, and promote opportunities for established members to go outside the boundaries of the learning event or focus. Encourage lurkers and voyeurs.
Integration	Articulate a set of belief statements, and identify group norms as they emerge and evolve. Adopt and firmly adhere to a learner-centered philosophy, and employ pedagogy that celebrates individuals while building a group identity.

Table 1. Representative implications of Selznik's elements for virtual learning communities.

Lifecycles of Virtual Learning Communities

It is reasonable to think of learning communities as having a life, one that goes through fairly predictable stages. There are at least three distinct stages: the formative stage, the mature stage, and the metamorphosis/declining stage.

The formative stage in the life of a virtual learning community is characterized by the attraction of new members. The identity of the community is malleable, and participants are typically somewhat tentative as they try out communicating and making connections with other community members. This stage of development requires a great deal of leadership. The leader at this stage is trying to set the tone of the community, attract and welcome new members to the community, and lay out the purpose and guidelines for participation with the group as it forms. At this point, the virtual learning community will be evolving from what its creators first imagined into what it will ultimately become. The purpose may change, expand or constrict, and it is the first place in which the members will either successfully or unsuccessfully impose their will on the makeup of the community. Users will test the boundaries of the community and determine whether they will remain as members. If required to be members, they will be deciding how significant the community will be to them, or how they can shape it into something they can use. In all, it is a time of testing, negotiating, and shaping, and the match between the purpose of the community and the importance of that purpose to members will determine the length of its survival and the strength of its influence.

The mature stage of life in the virtual community is ultimately achieved once the purpose, shape and operation of the community are settled. At this point the leader doesn't have to play as central a role in negotiating the purpose and monitoring the activities of members. The purpose and codes of conduct are known, and the members of the community exercise their control over the community by doing much of the monitoring. In later stages of maturity, the community is more institutionalized and entrenched. Codes of conduct are more rigid, as are the boundaries around acceptable topics and modes of expression. A mature community may start to take on the trappings of terrestrial communities, and become much more formal in its operation. This may be characterized by the introduction of some form of governing body or fund raising activities, for example.

Ultimately, most virtual communities will be challenged to change, to go through a metamorphosis and become a new entity with a focus that is different from the original conception of what the virtual learning community would be. It is possible that one indication of this change will be resistance to change—with the focus of those who manage the virtual community on the preservation of it; the focus on maintaining the organization itself rather than on extending its purpose or mission. One of the possibilities at this stage of life is that the virtual learning community has made its contribution and is now in a state of natural decline. There may be the rare virtual community that becomes so entrenched that it will survive without significant change, but most virtual communities will face greater volatility.

Research Issues Raised by Virtual Learning Communities

If educators choose to support the development of virtual learning communities, a number of issues emerge. Some issues are financial and logistic—how does one assemble the technological and personal systems necessary to construct and maintain a communication system. But the more important questions centre around the design, implementation, pedagogy and effects of virtual learning communities—the socio-educational aspects of learning through this means of communication. A few of these issues which invite investigation are listed below, although many more seem to arise every day.

- How do people select virtual learning communities and how do they make use of them for learning?
- How do voluntary members of virtual learning communities differ from those who are assigned to learning communities in formal educational contexts?
- Are there rules of engagement or particular protocols for insinuating an individual into the fabric of a virtual learning community, and is the process contextually or culturally bound? Does the process mirror interpersonal group learning contexts?
- Are there power relationships in virtual learning communities, and how do they interact with learning variables?
- Do Selznik's elements of community exhibit themselves in virtual learning communities, and do they inform our understanding of how these communities contribute to learning environments?
- What is the nature of learning in virtual contexts, and how do architects, active members and spectators describe their experiences?
- What value do administrators, educators and learners place on virtual learning communities? How do political, social, educational and personal agendas interact in the development maintenance and alteration of virtual learning communities.
- Do virtual learning communities exhibit lifecycles, and what significance does this have for their design?

- What are the pedagogical issues involved in virtual learning communities? How can they be used for teaching?

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Algorithm Animations supporting the Education in Distributed Systems

Arnulf Mester, Heiko Krumm
Dept. of Comp. Science, University of Dortmund, Germany
mester@acm.org, krumm@cs.uni.dortmund.de

Abstract: In order to support the education in distributed system fundamentals and to elucidate the function of distributed algorithms and protocols we apply animations of formal models which concentrate on the mediation of aspects of the dynamic system behaviour. For this purpose we adapted and extended approaches and tools supporting the animation of sequential algorithms. Besides of sets of special animations, the results comprise a set of view types providing for the convenient presentation of dynamic properties. Furthermore we report on experiences we gained from a series of corresponding educational experiments.

Introduction

With respect to the general introduction into distributed systems the experience shows, that many students have problems to grasp abstract conceptions such as concurrency, partially ordered causality structures, and nondeterminism. Moreover, even less abstract characteristics of distributed systems – like allocation of activities and resources to several sites, message exchange based cooperation mechanisms between autonomous parties, distributed state components, loose synchronisation, variable transit delays and faults in unreliable communication systems – cause problems since their demonstration mostly has to be based on non-trivial example systems which tend to be difficult to survey. In particular, subjects concerning the dynamic behaviour of distributed systems tend to overtax the imagination of students. Therefore, we developed animations of distributed algorithms and communication protocols in order to complement the traditional means of education by facilities which enable students to experience dynamic behaviours of models. The animations concentrate on the elucidation of distributed system characteristics, on the design of suitable views supporting the understanding of distributed systems, and on the exemplification of protocols and algorithms.

The animation of distributed systems is based on results imported from the research field of sequential algorithm animation (Brown 1987, Stasko 1998). In particular, we use the Zeus algorithm animation system (Brown 1992) which supports the animation of Modula-3 based algorithm implementations (Harbison 1992). Furthermore, there are animations accessible via World Wide Web which are implemented as Java-applets in HTML-pages (Arnold et al. 1998, Ragett 1998).

The objective of supporting the education in distributed systems by animations was pursued by a series of experiments. We started with the ZADA project (Mester w/o date). It was performed in the course of a so-called group project where about 10 students cooperate during one year in order to achieve a development project goal and to experience team work and cooperation means. The student group extended and applied the Zeus system and developed a set of protocol and algorithm animations. In particular, they designed suitable types of views supporting the visual presentation of the animations. The team presented its results to the audience of a fundamental distributed system lecture and learned from the feedback. The ZADA project supplied relatively universal animation platforms to students and suggested to them to design animations and to perform experiments for their own. In comparison to this, the provision of well-prepared and well-designed animations can structure and accelerate the learning process. Especially, it can help students to gain a first access to new subjects. Presently we therefore offer World Wide Web accessible lecture note complements which introduce into the field of distributed systems and provide for applets animating the execution of distributed algorithms and protocols (Krumm 1997). In the distributed system lecture references to the complements are made. The feedback from oral examinations is very positive.

Algorithm Animation

Algorithm animation is a section of software visualization, which Price et al. define as "Algorithm visualization or animation is understood to be the visualization of a high-level description of a piece of software, which is in contrast to code or data visualization (which are collectively a kind of program visualization) where actual implemented code is visualized." (Price et al. 1993). Algorithm animation is typically used as learning aid, as high-level debugging aid, and as design aid.

Most algorithm animation systems (e.g. Zeus (Brown 1992), Tango/Xtango (Stasko 1992) with several successors) provide for execution of sequential algorithms, interactive control, e.g. at least different speeds, single stepping, breakpoints, and algorithm input determination, as well as the mapping between the state and/or the actions of the algorithm onto the state and/or actions of some or all of its visualizations. Furthermore it synchronizes between the algorithm and its visualizations. Animation designers are supported with an animation library leveraging the effort of building sophisticated views (including animated graphics, 3D, sound). Animations built ad-hoc without an animation system would have to reimplement major features of this environment.

The architecture of Zeus separates between the algorithm and the views of the animation. One has to annotate the source code of the algorithm (Zeus: Modula-3) to be animated at 'interesting' (i.e., animation relevant) locations with directives to emit a stream of 'interesting events' to the animation system on execution. The animation system then filters the events according to the users interests, distributes the events to connected views (separate windows) and synchronizes among them, i.e., assures the concurrent handling of the same event in all views. Events normally cause display changes in views. The algorithm system may also provide for a channel back into the algorithm, i.e., manipulations of program data displayed in views effect changes of program data variables.

Still missing are systematic guidelines for successful visualization, though some empirical studies about specific aspects exists (e.g., Stasko 1997). The current trend in algorithm animation is its seamless integration into Web-based electronic textbooks / courseware, which also allow for other types of media. Another trend is to provide for collaborations between learners (e.g., Brown et al. 1997, Guzdial et al. 1997).

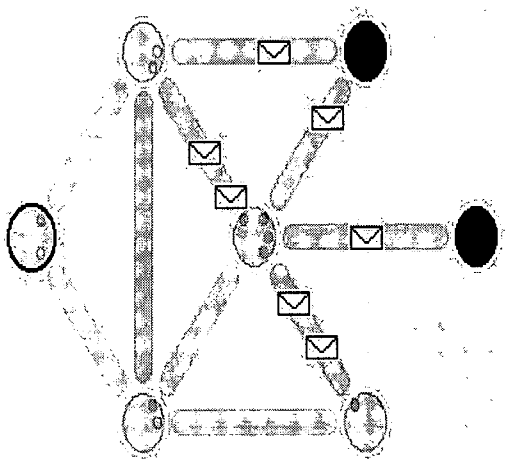
Distributed System Animation

In comparison with the animation of sequential algorithms, the animation of distributed systems imposes additional requirements. Animations have to handle the concurrency of activities. They must model the distribution of activities and resources to sites as well as the distances and transit delays between sites. Furthermore, the inherent non-determinism resulting from varying transit delays and processing speeds has to be managed. On the one hand, these requirements demand special features of the animation system. On the other hand, they ask for special design and layout principles in order to offer convenient presentation interfaces. Special features of a suitable animation system are:

- Distributed system definition language; it has to support the definition of processes with private resources and the definition of communication networks supporting the exchange of messages. Additionally, the definitions of the animation events have to be supplied.
- Scheduler; the execution of activities during animations has to be controlled by a scheduler component which achieves the selection, synchronisation, and management of concurrent and nondeterministic actions. Preferably, the scheduler provides for different scheduling strategies (e.g., arbitrary action selection, systematically exhaustive depth-first or breadth-first exploration, user-defined action priorities, user-interaction controlled selection) which can be combined with several processing speed controls (e.g., continuous processing with user-chosen processing speed, single-step execution, stop at break-points) and suitable experiment control strategies (e.g., forward processing, backward processing, reset, choice of alternative execution sequences, repetition of sequences).
- Node and communication system models; while distributed system nodes commonly are represented by event-discrete models which perform actions from time to time, the communication system preferably reflects the continuous propagation of signals over links. Therefore the execution machine has to support more fine-grained communication system steps as well as more course-grained node actions.

While concurrency and nondeterminism mostly result in complex and intertwined activity threads, the presentation interface of the animations has to provide for clear impressions which support gradual learning processes. In particular, special view types for distributed system animations are of interest. The views shall refer to common paradigms and emphasize the properties of interest.

The views influence the convenient perception of animations. Following main view types were identified and defined: a) Topology; the view depicts a graph representing the nodes and links of a network. b) Message sequence charts; time-distance diagrams clarify the propagation of messages. c) State machines; state machine diagrams elucidate the control flow of nodes. d) Petri nets; nets and 'token games' can support representations of the system and its concurrent threads of activity as a whole. e) Code; often, details of a system are preferably demonstrated with reference to its definition text where the constructs of momentary interest are emphasized.



(Fig. 1) presents the screen shot of an animation of a parallel network exploration algorithm. The figure exemplifies the topology view type which comprises icons of nodes, links, and messages. Message types are coded by color. Additionally, the major state component values of nodes are represented by the color of the node icons. The values of essential minor state components influence the color of links (i.e., the exploration state of a node and the state of the spanning tree under construction). Moreover, the bright points in the nodes act as indicators for minor state components of nodes (i.e., the management of exploration messages and acknowledgements).

Figure 1: Topology view
(live applet: http://ls4-www.cs.uni-dortmund.de/RVS/MA/hk/OrdnerVertAlgo/EchoAlgoText.html)

Thus, (Fig. 1) also exemplifies the graphical representation of state component values. We recommend to our students, firstly to observe system executions in this topology view, since it provides for an intuitive understanding of distribution, message propagation and concurrency.

(Fig. 2) gives an example of the message sequence chart view. It also presents an animation of the parallel exploration algorithm. On top of the picture we see the topology view again which is known from (Fig. 1). Mostly, we use the topology view as recurring main view. A mapping was applied which linearizes the topology area in order to support the direct correspondence of x-coordinates in topology and message sequence chart view. On bottom of (Fig. 2) the code view of the animation shows the definition of the last action of the selected node. The selected node is highlighted in the topology view. Since the selection feature is combined with a break point. The animation stops whenever the selected node performs an action and the user can investigate the definition text of the action.

Finally, (Fig. 3) depicts the state machine view. The figure is a screen shot of an animation of the Alternating Bit Protocol. On top, the topology view is used again as main view. Here, the minor state component values of the sender and receiver buffer contents complement the icons of the nodes. Below, the animated transition diagram of the selected node represents a state machine. Old and new states, as well as the fired actions are highlighted by colored borders. Note, that the state diagram concentrates on few major state components. Additionally, it is important, that the action names of the diagram directly correspond to the action names of the code view.

ZADA Project

Within the project 11 students and two advisors from the distributed systems group tackled the problem of making the comprehension of the functionality (i.e. dynamic behaviour) of distributed algorithms easier. The aim of the project was the development of methods and tools for an utmost simple generation of effective visualizations of protocols and distributed algorithms. As only few original work to this problem existed, which mainly focused on parallel algorithms or on examplary animations of isolated examples, this project was targeted more exploratory. The group explored existing animations and animation systems and quickly turned to both didactical and technical matters: (1) elaboration of guidelines for the effective visualization, (2) development of
an approach to and a tool for the modelling, the execution and the instrumentation of distributed algorithms, (3) selection and implementation of typical representatives for a broad range of distributed algorithms and protocols, and – based on the didactical guidelines – (4) exploration of visualization facilities (and implementing them as views) for this class of algorithms, as well as (5) evaluating meaningful views for the algorithms selected. To validate the ideas, (2), (3), and (5) have been bundled with the Zeus animation system to form a collection of 'Zeus-based Animations of Distributed Algorithms and communication protocols (ZADA)' (6).

(1) Not all that is technically possible also is didactically feasible. Therefore, a framework for the systematic design of animations was developed. It profited from contributions in cognitive psychology and science of education and covers topics like how to represent specific distributed algorithm event classes (e.g. message send/receive, loss, node state change), how to place views, how much information can be presented in one view, in how far views have to be explained or augmented, how much parallel activities are feasible, how to help the viewer to relate correlating activities in different views, which colors and color combinations fit best, what can be supported with sounds, etc.

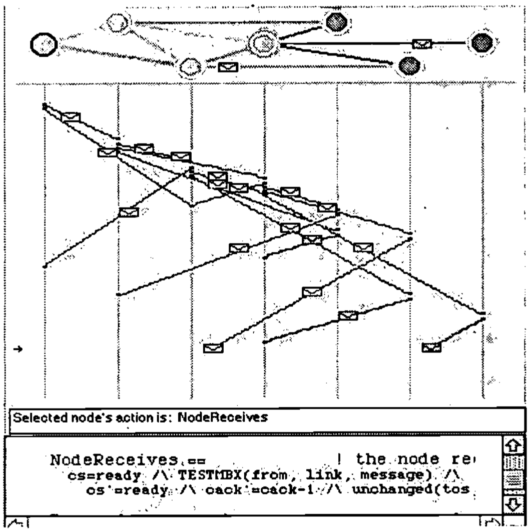


Figure 2: Message sequence chart and code view (live applet: http://ls4-www.cs.uni-dortmund.de/ RVS/MA/hk/OrdnerVertAlgo/EchoAlgoText1.html)

(2) For modelling, the Actor-model has been adopted and utilized in Modula-3. The adaption allows for a nearly direct take-over of pseudocode descriptions from common textbooks into a Modula-3 program for later integration into the animation system. For execution, Zeus has been selected as underlying animation system. It has been extended by an animation scheduler component which models the propagation of messages in the communication system and triggers the actions of the distributed system nodes. For instrumentation, standardized events for distributed algorithms have been defined (e.g. message send/receive, node status change), which are raised automatically by the animation scheduler without the necessity of further annotation of program texts.

(3) The selection of algorithms described abstractly in Modula-3 can be regarded as broad, since all relevant algorithm subclasses are represented: a) *application oriented*: consistency of distributed data, distributed transaction, and distributed computation. b) *control*: consensus, network exploration, adoption, backward error correction, election, net structure exploration, shortest path, and termination. c) *communication protocols*: alternating bit and sliding window protocol.

(4) The examination of possibilities for the visualization of distributed algorithms resulted in a collection of canonical and specific animation views. The views stem from the three animation view classes: direct visualization on different abstraction levels, functional visualization, and views serving as overviews. The following animation views were build: topology, instance, time/distance, petri-net, finite automata, message queues, area codings (polygon view), waves, state trees over time, checkpoints, and timer. Reusable views are parametrizable in their visualization characteristics at object instance-level (e.g. legend, colors, icons, action triggering by events). (Fig. 4) depicts an area/polygon view, where the major state of the local node is represented by a colored area around it. (Fig. 5) shows a wave view on the same topology, where growing circles represent spreading knowledge about e.g. a value.

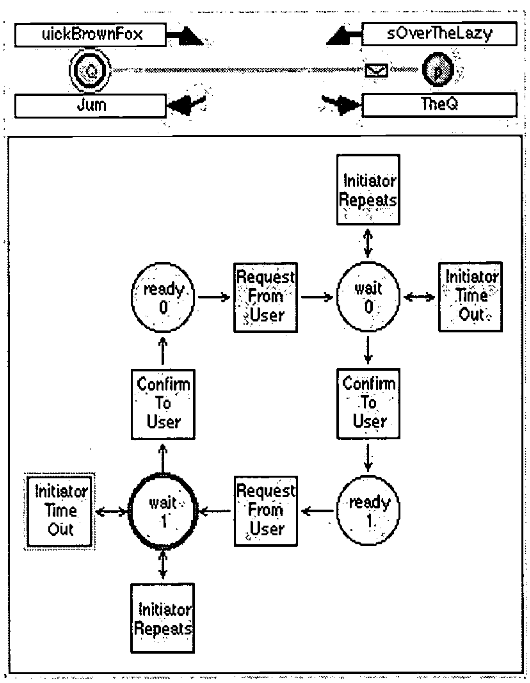
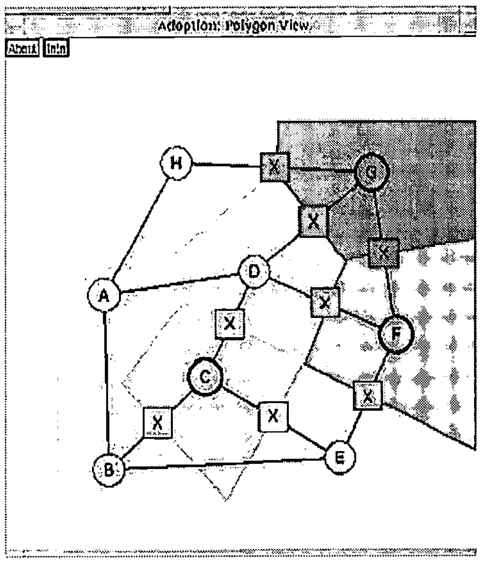


Figure 3: State machine view (live applet: http://ls4-www.cs.uni-dortmund.de/ RVS/MA/hk/OrdnerVertAlgo/AltBitText2.html)



(5/6) The collection of animations, suitable views, guidelines, modules, and experiment parameter files forms ZADA. In connection with animations it recommends experiment parameters to support common learning experiences: Specific settings (topologies, algorithm input data, initiator status, etc.) have been prepared and documented in order to facilitate a common base for discussions and individual explorations.
The ZADA package primarily adresses students in higher classes for computer networks and distributed systems. It serves as interactive tool for exploratory learning of selected algorithms. Mainly, the students will use the preplanned experiments. Moreover, advanced students can design experiments for their own. They can concentrate on the modelling of the algorithm, since re-usable canonical views and the standardized instrumentation provide for an automated creation of animations.

Figure 4: Adoption Area/Polygon View

Animations in Complementary Lecture Notes

We offer two courses which refer to animated models in complementary lecture notes. One course introduces into computer networks and distributed systems in general. The other course concentrates on distributed algorithms, their specification, and verification. The complementary lecture notes are accessible via World Wide Web (Krumm 1997) and can be experienced by Java-enabled HTML-browsers. Presently, the notes contain the following animations (introductions into these algorithms may be found in (Raynal 1987): a) Parallel network exploration, b) Serial network exploration, c) Message extinction principle, d) Distributed snapshot scenario, consistency, and snapshot algorithms, e) Alternating Bit Protocol.

Each topic is delt with a small series of animations in few different views. At the one hand, there is a lot of work necessary to develop convenient animations. On the other hand, we do not want to overload the perceiption of the students. Therefore, we presently provide for a relatively small set of animations only. We propose that the students start with the observation of a system in topology view in order to get impressions of the global behaviour. All other animations refer to the topology view as main view. Stepwise executions combining the topology view with the code view are of interest to introduce the formal system definition. It supplies the definitions of the process types containing the declarations of the state variables and the definitions of the process actions. A combination of topology and message sequence chart view can clarify concurrency and message propagation issues. Finally, state machine views can help to structure and understand the local behaviour of nodes. (Fig. 1), (Fig. 2), and (Fig. 3) are screen shots from such animations and exemplify this sequence of views.

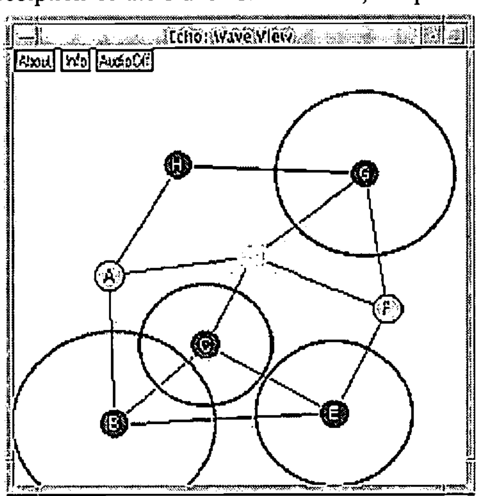


Figure 5: Wave View

All animations provide for restricted interaction facilities. Students may control the animation speed. They can start, stop, and continue an animation. Moreover they can select nodes in order to choose the focus of state machine and code views. The code view selection is combined with an automated break after each action of the selected node. Additionally, a general single step mode is available. There is a deterministic scheduling which is defined implicitly with the system definition. Some models provide for nondeterministic execution variants resulting from varying message delays. In general, we do not want to provide for an universal animation experiment platform. We only want to offer a small and preplanned set of marked animations which mediate the essentials in an efficient way. Animated topology and message sequence chart views shall support a first access to the properties of distribution, concurrency, and nondeterminism. Animations of the Alternating Bit Protocol shall exemplify the cooperation of protocol entities and their use of basic channels. Finally, animations of snapshot scenarios shall clarify the snapshot problem, the role of the causal dependency relation, and ist influence to the concistency of snapshots.

Results and Experiences

We used educational animations of distributed system models in two different ways. We reported on the work of the students of a project group which deepened their knowledge of distributed systems by developing an animation system, designing animations, and evaluating the feedback of other students to the animations. Furthermore, we outlined the World Wide Web accessible complementary lecture notes which support the introduction of distributed system essentials and aim to the time-efficient mediation of subjects.

As the experience showed so far, there are the following main aspects of animation application and animation design which should be coordinated with each other: a) Team objectives and size, b) Available period of time, c) Guidance, d) Scope of experiment design, e) Interaction facilities, and f) Animation development automation. For instance, the animations of the complementary lecture notes (cf. Sect. 5) are mainly used by single students, who belong to a larger course group but perform the experiments alone in order to support their individual learning. While there is no tuition which directly addresses animation experiments, the lectures preferably rely on common experiences of the students which result from the fact, that all students experienced similar experiments. To support the similarity of experiments, the scope of experiment design is relatively small and the interaction facilities are restricted. This is of interest also because our students tend to be very sparing with their learning time and consider well-prepared animations only. Therefore, the animations had to be designed creatively. Of course we used a common framework supplying basic features and guidelines. In particular, however, the design of suitable scenarios, the selection of meaningful state components, and the design of striking icons could not be automatized. They resulted from individual efforts and dominated the animation development.

Concluding Remarks

In summary, our experiences plead for the provision of animations for the education in distributed systems. In order to support more fundamental courses, however, the animations have to be designed very carefully and therefore bind many development resources. Hence, the exchange of animations between universities and cooperative developments are of great interest. They can be supported by World Wide Web and Java technologies, which also support access for students learning at home.

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Culture On-line: Development of a Culturally Supportive Web Environment for Indigenous Australian Students

Catherine McLoughlin,
Faculty of Community Services, Education and Social Sciences
Edith Cowan University
Western Australia
c.mcloughlin@cowan.edu.au

Abstract

The degree to which technology can serve the needs of culturally diverse students is dependent upon the adoption of culturally appropriate and inclusive instructional design models. We can adopt Papert's (1993) idealistic belief that "the computer changes who can do what, and at what age" and regard the computer as a tool for liberation, achievement and multicultural learning. But we must do more to realise the objective of culturally appropriate instructional design. Technologists and multicultural educators need to plan for cultural pluralism when planning and designing instruction and delivery options, if Web sites are to cater for diverse learning needs, cultural perspectives and learning styles. The design of a World Wide Web learning environment for Indigenous Australian students is outlined, and multiple cultural model of instructional design model that informed the development is discussed. The cultural aspects of the design process are outlined, and implications for design of Web sites for culturally contextualised learning are drawn.

Context of the study

The use of information technology by Indigenous Australians is very limited. As part of The Commonwealth Government's *Access and Equity Policy* in Australia, there has been increased funding to support greater Indigenous use of communications technologies and for information literacy skills. In 1998 Edith Cowan University in Western Australia successfully obtained funding to launch its pre-university bridging courses on the World Wide Web to cater for the state's Indigenous population. The online learning environment and content were designed to enhance the participation of Indigenous students learning in Web-based learning, and to increase their academic success through increased proficiency and awareness of computer technology. In addition, the initiation and implementation of the project was intended to produce other outcomes, such as insights into learning styles and how students responded to the on-line environment.

This paper describes the design and epistemology of a culturally appropriate Web site for the Indigenous Australian students who are novice users of the technology, and who are making the transition to tertiary studies. The project is planned to extend over three years, and in this time six units of a tertiary bridging course will be redesigned and made available to learners in an open learning mode. Until this point in time learners have accessed the materials in the print mode only. The project, entitled *Indigenous Online Network (ION)* aims to provide appropriate learning materials and contexts for Indigenous students to access study skills courses online, and provide a communications network for Indigenous Australian academics within Australia.

Theoretical aspects of WWW design: Cross cultural dimensions

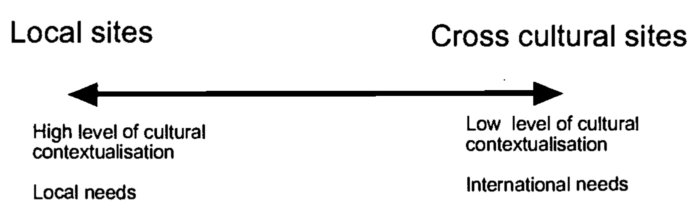
The question of cultural contextuality in the creation of a Web site for a specific cultural group can be regarded as a central issue in the design of both interface and learning activities. Often, minority cultures wishing to incorporate technology in their learning are not well served by instructional approaches designed for mainstream values (Roblyer et al 1996). As learning is a cultural activity, the design of a Web site is also infused with cultural meaning and with cultural nuances and identity issues, and instructional designers and developers bring their own viewpoints and perspectives to the design process. The World Wide Web can attract global audiences to the many sites that can be accessed. But to what extent is the

Web increasing cross-cultural understanding and bridging the gap between cultures? Can we assume that the content, interaction and learning experiences afforded by the WWW will have the same relevance and meaning to diverse audiences?

Collis & Remmers (1997) have defined two categories of sites that have cross-cultural implications:

(i) Sites that are made in context and culture, but visited by other cultures
(ii) Sites designed specifically for cross-cultural participation. (See Figure 1.)
The provision of Web sites for Indigenous Australian students would fit into category one, as they are intended to cater to the needs of a particular cultural group. In designing a Web environment for this target group, it was envisaged that other Indigenous groups and individuals from around the world would visit the site. However, the primary objective was to cater for the needs of Indigenous students seeking a bridge into university. In applying an instructional design model for the sites, our objective was to create a culturally appropriate learning environment for the design of this and future sites for Indigenous students. Primary considerations were influenced by the educational values, needs and learning styles of Indigenous Australian students, and the integration of these cultural variables into the design process. In addition, it was hoped that the initial experience of the students would be monitored so that feedback on learning processes and on line interactions would enable us to further refine Web sites tailored to the specific needs of these learners.

Figure 1: Categories of Websites



Indigenous epistemology and values

Our first step in designing the Web site for the Indigenous students was to ensure cultural inclusivity in all aspects of pedagogy, form of interaction and learning processes. This involved review and analysis of a broad range of literature and extensive consultation with Indigenous students, community members and academic staff. In order to define and plan instruction for the particular educational setting, the adoption of an appropriate instructional design model was essential. Henderson (1996) reminds us that instructional design is an intangible aspect of culture, but once it is transformed into a material object, it becomes an artefact of the culture is which it is embedded. In support of this view, Flechsig (1997: 27) affirms that " instructional 'designs' are specific ways of cultural transmission and of organising learning processes". From the outset, therefore, the design process was infused with the awareness that the development of the Website should be contextualised within the epistemology, pedagogic philosophy and models of knowledge construction that underpin Indigenous values and approaches to learning.

The literature on Indigenous epistemology provides several insights that can inform the design of learning activities and pedagogy. Christie (1988) suggests that in genuine Indigenous Aboriginal education the basic goal is to teach the harmony and unity of Aboriginal life. An important goal is to preserve continuity with the past, the land and the people. From an Indigenous perspective, cultural integrity and survival are fundamental concerns. Triandis (1990) describes the distinction between individualism and collectivism as the most important dimension of cultural difference in social behaviour. If it is accepted that Indigenous students differ significantly from peer groups of non-Aboriginal students concerning values that serve collective/community as opposed to individual interests, this is likely to have planning and design implications. In practical terms, for the design of the learning environment, this involved:

- community-based communication processes and task orientation;
- consultation and decision making by Indigenous students; and

• participatory planning in the design process.

For adult Indigenous learners, cognitive orientations to instruction have been found to be unsupportive of traditional values and ways of learning (Ryan, 1992). Instead, educational models based on concepts of community and social participation have been found most productive (Whatman, 1995). The successful design of the Web site therefore depended on the adoption of an instructional design approach that was congruent with Aboriginal values, participatory structures and way of communicating.

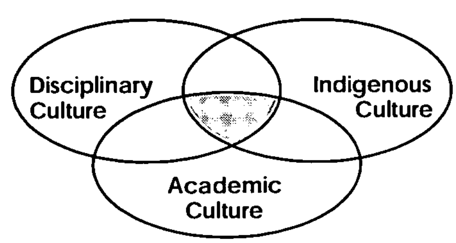
Throughout the planning stage, there was constant discussion within the Indigenous community about content, graphic design and instructional approaches. To further support the cultural relevance of the site for Indigenous learners, it was essential to conceive of the development within an appropriate theoretical framework.

Theoretical framework

Through the process of consultation, two interrelated theoretical models of learning were found to be supportive of Indigenous values and pedagogies. To support the notion of community, the creation of a 'community of practitioners' (Lave, 1991) affirmed the processes of dialogue, shared interest, participation and collaboration. This concept permeated the design at various levels, from the creation of the on-line environment through to the design of learning activities, support structures, and collaborative links with the community. For students, the concept of belonging to an online community resonated with their own community-based expectations, and allowed them to see technology not only as a means of widening their own circle, but also as a means of taking newly found skills into their own communities. Thus, the social, communicative and collaborative aspects of the 'community of practitioners' approach were culturally appropriate. For Lave & Wenger (1991), social action and communicative praxis are primary, and learning is both social and a language based practice. Another tenet of this theory is "the increased access of learners to participating roles in expert performance" (Lave & Wenger, 1991: 17). This means that learners are always participants in the learning process and acquire greater expertise though observation, and "legitimate peripheral participation" (Lave & Wenger, 1991:29). Even as novices, learners have access to different levels of activity, and learn initially by taking on simpler tasks but gradually moving towards full participation.

Supports for learning and collaboration were incorporated into the design and were conceptualised and augmented by the theoretical framework of Vygotskyan theory (1978) in which learning is viewed as being a participant in a particular social world. For Vygotsky, learning is development, and through the processes of social interaction and dialogue with more experienced others, learners are assisted in achieving higher levels of competence. Another fundament tenet of Vygtoskyan theory is that learners continually re-enter new zones of development recursively throughout their lives. As technology is increasingly used to deliver instruction and to facilitate communication, information literacy skills for Indigenous students can be interpreted as entering new zones of development. For Indigenous learners, it is nevertheless important to retain their own sense of cultural identity, and to integrate new skills with other learning needs, ie tertiary literacy skills and Indigenous cultural knowledge. (See Figure 2).

Figure 2: Multiple cultural model of online learning



The "zones of development" for Indigenous learners on-line would therefore have to combine the skills associated with the academic culture, of university with Indigenous cultural perspectives and relevant disciplinary skills for tertiary success. By integrating the participatory pedagogy of Lave & Wenger (1991) based on a community of practice, an emancipatory learning experience was conceptualised as collaborative groups of learners working at appropriate levels while acquiring new skills. In this way, a theoretically valid and culturally appropriate pedagogical framework was developed for the Web site.

Instructional design: Limitations of existing models

Linked to the theoretical framework of the community of practitioners, an instructional design model was sought to support the learning activities of sharing knowledge and learning through participation, while recognising the unique cultural tenor of the Web site. There are many current instructional design models and paradigms, each of which can be interpreted as culturally and socially determined (Branch, 1997). Instructional designers however, may not always incorporate cultural understandings of technology into the design of learning materials. Instructional design models include cognitive, social and pedagogical issues, but may not acknowledge the need for cultural contextuality. Reeves & Reeves (1997) for instance, outline ten pedagogical dimensions that can be used to design interactive multimedia tools and learning environments. Cultural sensitivity is described as building in diversity and adapting instructional design to cultural norms. Henderson (1996) argues that cultural issues are fundamental, as instructional design is about the creation of cultural identity: "Instructional design cannot and does not, exist outside of a consideration of culture" (Henderson, 1996, p. 86). In creating a learning space for Indigenous learners, the development team had to ask: *How can the dimension of cultural contextuality inform the instructional design process?*

An important part of Henderson's (1996) work is the identification of several design paradigms, each of which reflects particular world views, values, pedagogies, inclusions, and exclusions that result from the designer's own societal context. As instructional designers are instrumental in creating and developing interactive multimedia, courseware and learning environments, they can also influence cultures of learning. Among the paradigms identified by Henderson (1996) there are three, all of which are limited with respect to cultural dimensions of learning and pedagogy. For example, the inclusive paradigm which is motivated by equity issues, acknowledges diversity and multiculturalism in the design of learning materials. However, this type of design tends towards soft multiculturalism which ignores the complex issues involved and includes only superficial aspects of the minority culture that do not challenge the majority view. The inverted curriculum approach takes the minorities' perspective, and criticises the status quo, or dominant group pedagogy. However, it does not empower students who must try to survive within the mainstream academic culture.

This consideration of ID models alerted the development team to issues of tokenism, soft multiculturalism and cosmetic multiculturalism. To arrive at an appropriate design model, several questions were posed to all interested parties, including prospective students, community members and teachers, so that the design would be informed by Indigenous perspectives.

- What kind of learning environment is most familiar to the students?
- How does the cultural background of the students influence their use and view of time?
- How do Indigenous students conceive the role of the teacher?
- What kind of relationship do students want with a teacher?
- What kinds of assessment tasks will be fair and unbiased?
- What rewards and forms of feedback will be most motivating for these students?
- Is the locus of control congruent with these students' own sense of personal control?
  What cognitive styles characterise the target group?

Responses to these questions contributed to the development of the Web site and to the creation of learning activities, pedagogical support and collaborative task design. The adoption of an 'eclectic paradigm' or multiple cultural model allowed variability and flexibility and that enabled students to learning through interaction with materials that:

- reflect the multicultural realities of society;
- include multiple ways of learning and teaching; and
- promote equity of learning outcomes.

The adoption of the multiple cultural model is reflected in different 'zones' of learning that matched the cultural experience of Aboriginal students entering university. (See Figure 2.)

Pedagogical features of the on-line community

A constructivist approach aligned to student centred approaches to knowledge interpretation was built into the design process. As knowledge extended beyond the classroom into the community, the concepts of knowledge and teaching were redefined for the Indigenous learners. The creation of a community of learners online was achieved through task design, communication forums, shared spaces for working and collaboration and dialogue and support from peers and tutors. Each distributed group of students had an online mentor or virtual tutor who provided feedback and fostered further dialogue.

A broader view than just designing instruction for mastery of content was adopted. The Web site fostered conceptual transformative learning by creating a holistic learning environment where social processes, community consultation and learning strategies for tertiary study were built in. These features are summarised in Table 1.

Table 1: Features of the online community of inquiry

Feature of community of inquiry learning	Cultural/cognitive application
• Epistemology and pedagogy congruent with community needs	Socially situated learning based on Lave's (1991) community of inquiry
• Communication forums and interaction	Negotiation of shared meaning; peer teaching and conversation
• Shared experience and knowledge	Participatory tasks, collaborative learning and group projects (Scheel & Branch, 1993)
• Supportive teacher roles and responsibilities	On-line tutors scaffold learning through mentorships, dialogue and modelling
• Creation and manipulation of shared spaces	Use of bulletin boards for shared experiences and talk; Use of the larger space of the WWW to find & share resources
• Student roles and responsibilities	Clear statements of outcomes; negotiable tasks; posting of shared problems to a FAQ space
• Situated discourse and collaboration	Use of Lipman's (1991) model of inquiry: mutual, questioning, feedback & deliberation through problem-based tasks
• Support mechanisms within the community and outside the community	Access to peer scaffolding; outside experts. mentoring by online tutors through online help, group forums
• Social interaction to support group cohesion	Use of multiple forms of communication and dialogue & tasks designed for collaboration.

Task design incorporated instructional tools to enable students to formulate and develop responses to problems, and develop culturally pluralistic ways of perceiving information and skills. This approach was based on Vosniadu's (1994) notion of conceptual change as embedded in existing conceptual structures and revisions of these through authentic learning experiences.

By providing a community focus for learning and task design , the Indigenous learners were able to make connections with the instructional environment itself, through the use of culturally familiar metaphors, icons and graphical features. Consideration of the socio-cultural backgrounds of the learners and their styles of learning ensured that the learning tasks and processes of instruction were embedded in culturally sensitive contexts that validated Indigenous ways of learning.

Apart from celebrating cultural diversity, the design of the Web site for Indigenous Australian learners shows how technology can be used to support contextualised design and enhance student achievement by explicitly acknowledging the learners' unique cultural perspective.

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How Do Instructors Design A WWW-Based Course-Support Environment?

Wim de Boer & Betty Collis
Faculty Of Educational Science and Technology
University of Twente, PO box 217
7500 AE Enschede, The Netherlands
w.f.deboer@edte.utwente.nl, collis@edte.utwente.nl

Abstract: After one year (1997-1998) of working extensively with our instructors, particularly all of those responsible for our first-year courses, 17 courses required for all students and several senior elective courses (3) are now using their tailored-made Web-based course-support environments. In addition, during the 1998-99 academic year all of the second-year courses will be adapted to be delivered with their new course-support environments. In this paper we describe how a broad range of instructors, not only those who volunteer or have an initial interest in using WWW-based course support, but also those who are required to do so as part of a faculty-wide change process work through a design process based on rapid prototyping to evolve tailor-made WWW-based course-support environments. What are the options instructors choose for these environments and how popular are various types of options (for example, shared workspaces, WWW boards for computer conferencing, etc.) for course-support environments? Trends and implications in the set of options chosen by instructors in our faculty are discussed.

Introduction: TeleTOP at the University of Twente

The University of Twente in The Netherlands has national and international reputation in the field of telematics, the combination of information and communication technologies. Not only is there an extensive amount of research being done in the area but also the application of telematics applications to the teaching and learning process, what we call "tele-learning" (Collis, 1998) has a high priority. The most ambitious of the tele-learning initiatives at the University of Twente is the *TeleTOP* project in the Faculty of Educational Science and Technology. The overall goal of the project is to stimulate the innovative and appropriate use of telematics for learning purposes within the faculty in order to make the educational delivery more efficient, more enriched, and more flexible.

To achieve these goals a special system has been developed by a professional team of educational and technical designers and developers. The system is database-driven and Web-based and uses a variety of telematics applications, ranging from e-mail and Web pages to shared workspaces. The system generates WWW-based environments are meant as course-support environments for the instructors and students and not as replacements for face-to-face sessions and textbooks. Contact between instructors and students still is one of the essential aspects of a learning process (see Tielemans & Collis, 1998, for a further description of the educational and technical requirements for the system and how they have been realized).

However, no matter how elegant a system is, instructors must use it. Reasons that instructors in higher education do not make use of computer-based resources to support the instructional delivery of their courses are well known (see for example, Northrup (1997) and Collis & Pals, 1998). With respect to WWW-based environments, most current usage in mainstream programs in higher education is voluntary, and although there are an extensive number of examples of such voluntary use there are far many more instructors who are not making use of any of the instructional possibilities of telematics. There are relatively few examples of efforts to engage all the instructors in a faculty in the use of telematics applications in their courses. Merlic and Walker (1997) describe the *Virtual Office Hours* environment at the Department of Chemistry and Biochemisty at the University of California as one such example. Another is the TeleTOP Project at the University of Twente.

The decision (made by the faculty administration) to involve all courses in a re-design process, both pedagogically and to include use of telematics tools and WWW sites, involves the challenge of working with a wide variety of courses and instructors. To do this we have developed a WWW-based decision-support tool which we use as part of a rapid-prototyping process designed to maximize instructor involvement in the re-design of his or her course. Our situation has also given us an excellent opportunity to study what instructors actually want and use when given the possibility of a wide range of WWW-based tools and suggestions for using those tools. In the next section we describe the rapid-prototyping process.

Supporting Instructors in the Decision-Making Process when Designing a WWW-based Course-Support Environment

WWW-based environments to support all of the first-year courses in the Faculty of Educational Science and Technology were ready in a definitive form at the beginning of June 1998. How did this come about? Beginning in September 1997, a weekly instructors' session began in the faculty. These sessions were voluntary, and well attended. During the first two months of the sessions, instructors were introduced to a way of thinking about their courses, in terms of a matrix in which the rows are standard components of courses (course-organization aspects, face-to-face sessions, self-study and practice activities, projects and major assignments, testing, and general communication) and the columns relate to three motivations for change in each of the components (to make the component more efficient for instructors and students, to enrich the component, to make the component more flexible for different types of students). Links to examples of how telematics applications could support each category of change were demonstrated and discussed.

In November 1997 instructors were encouraged to consider their own courses and make a list of re-design options with could be facilitated by a WWW-based course-support environment tailored for their own particular courses. In December 1997 one-hour individual instructor sessions with the instructors of each of 21 courses were organised (all the first-year courses and a variety of other courses). The primary goal of the session was to use the especially made TeleTOP Decision Support Tool (DST) (Collis & De Boer, 1998) in order to interact intensively with the instructor whose course was being re-designed, trying to identify which WWW-compliant tools and associated pedagogical approaches are most likely to be acceptable and interesting to the particular course of the instructor and his/her way of teaching. For each of the course components a number of questions were asked relating to ways that a WWW site could be used relative to that component. Links to examples, primarily from courses already using the WWW in our own faculty, were provided for every question. Figure 1 shows a portion of the DST, with the overlay screen showing the example available from the link associated with a particular question. Immediately after the last of the questions in the DST was completed, a WWW page was generated for the instructor summarizing the choices that had been made, and providing the example links for those choices so that the instructor could further consider them via the use of an ordinary WWW browser at his or her convenience. This site generated by the DST served as the product of the first round of rapid prototyping.

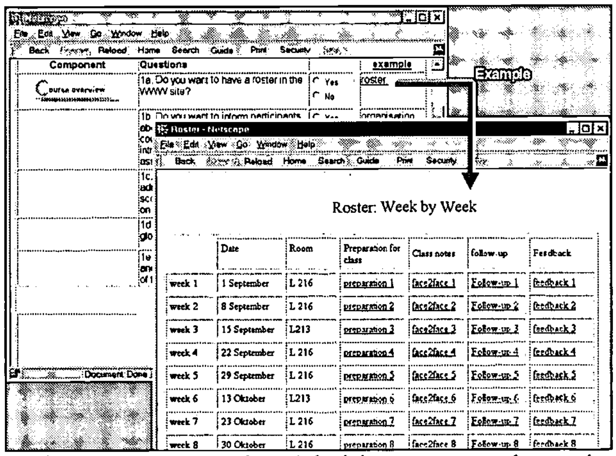

Figure 1. A screen dump of the WWW-based decision-support tool: questions and examples.

The second goal of the DST session was to respond to the instructors' reactions with ideas and suggestions, as well as to skip suggestions which did not seem like they would be comfortable for the instructor. The tool made it easier for instructors to make decisions with regard to making (some of) the components of their own courses more efficient, enriched and/or flexible in their new WWW-based learning environments. The instructor needed to decide what he thought was appropriate for his or her course. Twenty-one sessions, one per course, were organised in December and January 97/98 according to this approach, with one or two instructors participating and the authors carrying out the interview with the support of the DST at each session. A follow-up visit in the instructor's office one week after the DSST also occurred, to walk through the first site from their decisions with the DST, and make a second round of refinement of those decisions. Following this, a first prototype version of a course site tailored to the instructor's choices was generated, through the use of the TeleTOP database system. This process is being repeated in the same period in 1998-99 for all the second-year courses.

The next step for the instructors was to come together every week and practice with these prototype environments. The *Wednesday sessions* in which this occurred became an important part of the implementation process. Instructors had the chance to work together and exchange ideas. A few months later the instructors again went through the process of using a second WWW-based decision tool, choosing a final set of options for their course-support environments. As a result of this rapid-prototyping process, instructors not only are closed involved in the design process of the WWW sites that will support their courses, but also develop competency in handling those sites and the associated telematics tools and applications. The results of the process are tailored course-support environments, and also the creation of a sense of community among the instructors and a heightened level of awareness and literacy throughout the faculty with regard to the handling of telematics applications, network issues, and the instructional integration of telematics applications into regular courses.

Instructors thus had an extensive opportunity to try out a large variety of telematics tools and applications over the course of the rapid-prototyping process. What options have they actually chosen? In the following section, a summary of the options eventually selected by 21 courses in the 1997-98 cycle is given (see also Dijkstra & Collis, 1998, and Winnips, Collis, & Moonen, 1998, for discussions of two of the courses in detail).

Designing A Course Environment: The Options Chosen

During the second round (April, May 1998) instructors could make a final list of options for their course environment. Table 1 gives an overview of the options selected by the instructors for their environments.

Table 1. The options chosen for the WWW-based course-support environments

Component	Options	Description
General course information, self-study, lectures and support	News	A place for up-to-date information
	Roster	This is an important part of the environment and the ideas behind it. Here, instructors can put their study materials, assignments, sheets, notes and feedback related to the lectures.
	Quizserver	This option enables easy-to-make (self) tests.
	Course information	A course description can be put here. Think of goals, organisation, assigned text, which books, etc.
Communication	Email	In the mail-centre addresses of individuals and groups can be found. Mails can be send from here.
	Discussion	The discussion area can be used for a-synchronous discussions.
	Question and answer	Same as the discussion area, here with the focus on question towards the instructor.
	Chat	Synchronous communication.
Group-work	GroupWare	An easy to use file management area, for collaborative work.
	BSCW	A more advantaged file and communication management area, for collaborative work.
	Presentation	Presentations and other products can be presented in this part.
Resources	Glossary	Area where concepts can be explained. Relations with other areas can be made clear as well.
	WEB links	Resources: web pages on the WWW
	Multimedia	Resources: to the multimedia database.
	Search	A search centre: within the course environment or the WWW

The options *Newsflash*, *Roster*, *Course information* and *Email centre* were chosen by all instructors and thus are being strongly advised as the basic environment for the new round of courses being tailored during the 1998-99 academic year. The other options were chosen in various combinations by the instructors. Instructors with specific needs could get more tailor-made options. Figure 2 gives an overview of the percentages of the instructors who choose each of the above options. These numbers are based on the first 21 courses, of courses being offered between April 1998 through April 1999.

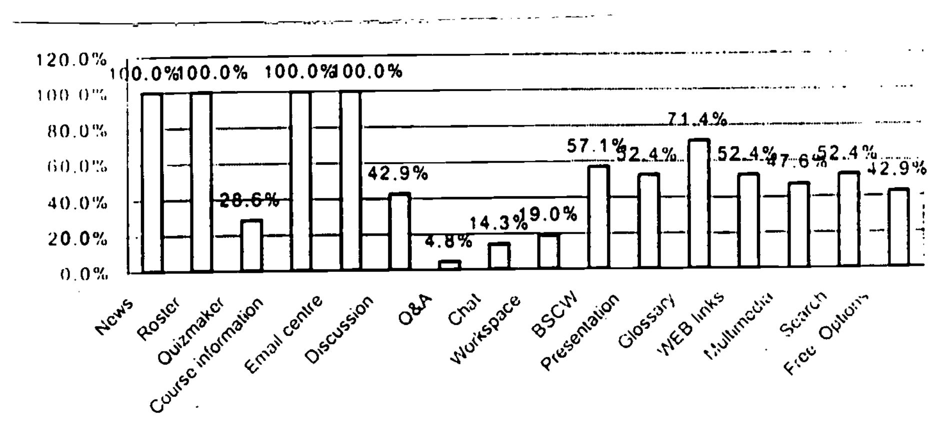

Figure 2. Percentages of instructors choosing various options (N=21).

Using the Course Environment

At the start of the academic year 1998-99 three courses had already used their WWW-based environments and seven courses were ready to start (timetabled in the first trimester). Participating in the courses are not only our regular students but also a new group of students participating mainly at a distance while remaining in the workforce. The latter group of students come one day every two week to thé University for a variety of face-to-face sessions. All the other courses that had been through the rapid-prototyping process were busy organising their environments, while learning from the experiences of their colleagues. Figure 3 is a screen dump of one of the course environments. At the left side of the screen the list of chosen options can be found. This is the menu area. At the right side all information will be displayed. All courses have a similar interface design, but differ in their chosen functionalities.

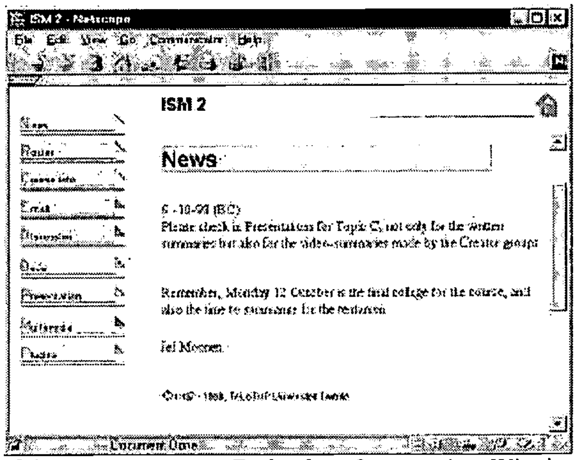

Figure 3. The Home page of the *Instrumentation Technology 2* course (see Winnips, Collis, & Moonen, 1998).

One part of the environment support the on-going organisation of the course. We call this the roster area. All instructors use the matrix-like rosters. This area helps them to place all organisational messages and materials needed before, during and after each contact session. Students can find the self-study materials or instructions in the roster. They can find the lecture notes and sheets and possible follow-up assignments, and can submit their assignments and comments directly via the roster. Instructors do not receive these submissions in their ordinary e-mail. All submitted materials are directly posted in the WWW environment, where the instructor can access them in a systematic way, whenever and wherever he or she chooses. The instructor needs no special software environment or tools; only a normal WWW browser and ordinary Internet access. Figure 4 is an example of such a roster, used in the *Instruction Design Theories* course, 1998 (see also Dijkstra, Collis, & Esryel, 1998).

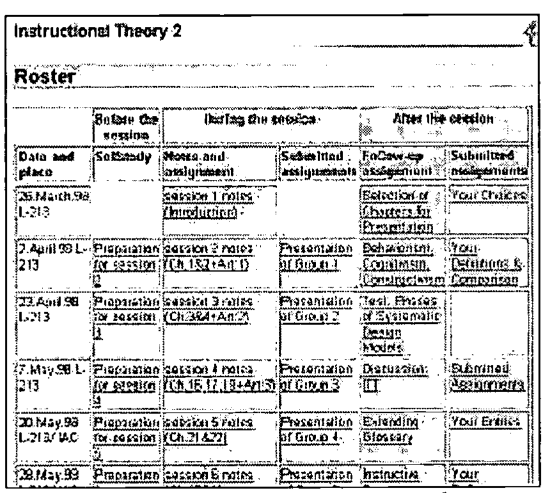

Figure 4. The roster of the *Instruction Design Theories* course

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Conclusion

The TeleTOP rapid-prototyping approach, supported by two versions of a WWW-based decision-support tool, is a managable and effective way to involve instructors in the re-design of their courses, and at the same time in skill development at handling WWW-based tools and environments. The options chosen by the instructors build upon their existing ways of teaching, but extending these, primarily through opportunities for the students and the instructor to efficiently communicate and for students to add new resources to the course sites as follow-up assignments between face-to-face sessions. We believe this approach, building upon the instructional methods already familiar to the instructor, is a useful strategy particularly when instructors who would normally not consider making use of a WWW environment are involved. The approach also works for instructors already experienced with WWW environments as well. For more information, see http://teletop.edte.utwente.nl

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Intelligent Multimedia Educational System on Distributed Environment

Kyungseob Yoon
Dept. of Computer and Information System, Inha Technical College, KOREA
ksyoon@true.inhatc.ac.kr

SeiHoon Lee
Dept. of Computer Engineering, Inha Technical College, KOREA
seihoon@true.inhatc.ac.kr

Chidon Ahn, Yunsoo Lee, Yeongtae Baek
Dept. of Computer Science and Engineering, Inha University, KOREA
{joheunid|yslee|hannae}@selab.inha.ac.kr

Abstract : *This paper suggests a multimedia educational system which has the ability to extract intelligent instruction on the distributed environment. The proposed system is designed for supporting individual instruction and real time user interaction. As the system based on CORBA, it has ability for distributed computing facilities. Using MHEG standard, we can provide multimedia courseware and real time user interaction. To diagnose students' responses and generate evaluations, we use several linguistic variables and fuzzy theory.*
There are two major advantages for using this system. This system can provide dynamic generation of problems and the ability to provide a dynamic instruction strategy. And it can increase reusability of courseware material for using standard of multimedia representation and communication. We use CORBA and MHEG to overcome the disadvantage of the Web, passive protocol and poor interactivity, HTTP.

1. Introduction

The Web has been spread world wide as a standard of distributing multimedia/hypermedia information. There are many applications, include distance learning, based on the Web. The advantage of using distance learning on the Web is apparent. We can provide instructional information using a hypertext form, the same as students' cognitive structure[Cravener 98]. But there are some disadvantages using the Web: passive protocol and poor interactivity[Bolk and Britton 98]. These problems can be overcome with two models, that could be integrated in WWW. A uniform paradigm to encapsulate and structure web components can be achieved thanks to the OMG's CORBA[OMG 95]. And real time user interaction facilities can be achieved by international standard, MHEG[ISO 95].
Despite the WWW is able to access distributed information and services on Internet, it can not provide individualized information to students[Bolk and Britton 98]. In addition, unlike existing stand-alone ITS, students must have the ability to study freely and search related information easily. Therefore the system must overcome potential disorientation problems that could burden accessibility.
In this paper, we suggest an intelligent multimedia educational system that can make intelligent instruction and individual instruction on distributed environment. Our system can support concurrent learning and dynamic lesson planning for each student by using linguistic variables and fuzzy theory. In addition, our system provides instructional units in which students' response are diagnosed, and compared, thereby allowing dynamic instructional strategies to develop in step with the students' progress.

2. Consideration for Multimedia Educational Systems

In this chapter, we consider major problems for developing multimedia educational system on the Web.

2.1 Problems of the Web as educational infrastructure

Students do not require only delivering information, but learning altogether. The major problem when developing educational system on the Web, is very weak interactivity. For students to learn more effectively, they need a high degree of interaction. But most current Web material is represented as HTML, so the Web today provides only low level interaction[Bolk and Britton 98].

The second problem is poor ability for representing materials. Because the Internet depends on HTML, the materials seem to poorly designed books with hypertext capabilities[Bolk and Britton 98].
To increase interactivities and multimedia facilities, there have been many studies such as Java, CGI, ActiveX, and some extensions of HTML. But these methods are not fit for educational requirements. Most students need individual learning only for themselves. When considering difference among students, this is very important. But the Web lacks capabilities for individual learning.

2.2 The MHEG standard

The MHEG standard provides representation of multimedia objects on heterogeneous networked environment[ISO 95]. It can support real time user interaction when presentation. Multimedia information, which encoded by the MHEG standard, is the MHEG object. As using MHEG objects as inherited form in applications, we require an environment to present these objects. The MHEG standard defined such environment as "engine" [ISO 95].
The MHEG-5 standard is the fifth subset of the MHEG standard. It defines some classes in detail. Those classes are appropriate to some applications such as video on demand, audio on demand, interactive TV and hypermedia navigation [ISO 96].
So, we apply MHEG, the standard of multimedia information representation, when developing multimedia educational system on the Web.

3. System Design

In this chapter, we design multimedia system that has intelligent educational capabilities. Figure 1 shows the system configuration.

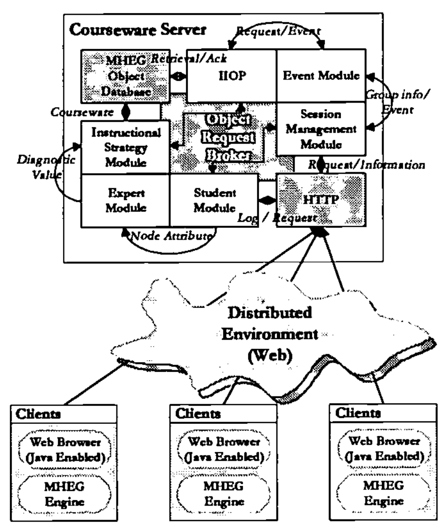

Figure 1. System configuration

When learning, students execute web browser that is able to run Java applet. Through log in process, courseware server sends materials to students in forms of MHEG objects. Client browser, include MHEG engine, presents those materials to them. The system logs student's learning history into student module, and diagnoses them in expert module, and decides student's next course in instructional strategy module.
When students participate in synchronous education program, such as video lecturing, session management module monitors students' activities. Event module processes happened user events, and interact with educational modules include student module.

3.1 Educational Modules

Educational modules consist of expert module, student module, and instructional strategy module.

3.1.1 Expert module
The domain knowledge will be used in coaching the students, diagnosing possible misconceptions after a student has made an error, and providing appropriate remedial materials. This domain model has dual representation network, the IUN(Instructional Unit Network) and the CN(Conceptual Network).

Within the IUN, each node represents a learning unit, and it includes the theme of units, learning aim, the link of the concepts related to the learning units, the links to the problems, and the links to the subordinate units.
There are two types of the instructional unit. One is the explain unit, the other is the problem unit. The explain unit has instructional materials that have various media types such as text, graphic, still image, sound, and moving picture. The problem unit has two major concept to diagnosing the student's state, difficulty and importance. These concepts are used when lesson planning and gradual instruction objective creating.
The CN is a knowledge network that piles up the knowledge of being contained in subject domain to be learned by the student. The CN is a data structure, which is a set of collected knowledge concerned with the declaring concept of domain knowledge, but independent upon the instructional knowledge. Each node within the CN represents the instructional concept, and the links between the concepts indicate the relationship of them. Using these relations, it is possible to generate problem dynamically, and to diagnose the student's error.
According to environments of the CORBA, expert module can access CORBA ORB to assist easy retrieval of materials, and URL indexing and caching demon to improve performance of system.
Unlike existing stand-alone ITS, user verification have to be supported so as to provide the individual learning according to the rate of each student.

3.1.2 Student module

The instructional strategy module uses the diagnostic result generated by student module in order to inference the basis for determination of learning progress, supplying advice, and selecting comments. In this paper, the student module is based on the overlay model. The diagnostic results of the student, problem type, and examples are saved at nodes in the student knowledge network. And the form of student knowledge network represents the learning path.
When the domain knowledge expert constructs the IUN and the CN by means of authoring interface, the two networks contain slots represented by linguistic variables for holding importance and difficulty that are the attributes of each problem and instructional unit.
The linguistic variables about the problem are used for diagnosing student's response. Using the linguistic variables, the domain expert can input at more user-friend environment because of being able to use linguistic variable and no need to decide special real number for attributes of all learning elements. The linguistic variable is the kernel of fuzzy theory that makes use of the fuzzy representation of human being in computer. Using the concentration and dilation in the fuzzy theory, we can define the function that diagnoses the student's current knowledge
The author can change the membership functions upon "Good", "Medium", and "Bad", and the diagnostic results can also vary according to the membership function applied. Hence, the author can control the diagnostic results by changing these three membership functions.
Normalization is defined as follows: suppose that all problem is correct, then, calculate the DV and divide into the result of calculation about correct answer. If the importance and the difficulty are applied at the same time to the same problem, select one that minimizes the membership degree and applies it.
To use more various values for representing the importance or the difficulty, we must consider modifiers applicable to the linguistic variables
regardless of its number of repetition. Hence, the inconsistency of diagnostic result caused by repeated applications of the modifier is removed. For example, "Easy" is never less than "Very Easy" in spite of the number of "Little" modifier's applications.
The calculation result by DV function for the diagnosis of student's response is a real number that ranges between zero and one. To execute fuzzy inference using linguistic variable, result obtained by the DV function has to be fuzzified. Fuzzified result is one of the linguistic variable that consists of Good, Medium, Bad, and the modifier $[Very]^*$, $[Less]^*$.
If we fuzzify the diagnostic results into the linguistic variables, then they can be used together with the inference rules using the linguistic variables.
If the author input the inference rule and there was conflicting among those rules, that is, different result is input at the same condition, the author is presented the condition and is asked what result should be used. The result of learning, whether well or poor, is determined according to what deterministic variable is input by the author. This shows that the author's intention can be reflected to inference rule.

3.1.3 Instructional strategy module

The instructional strategy module mediates and develops the learning of the students through the planning of a curriculum to order the domain knowledge that must be supplied to students, and the planning of teaching to decide the presentation method, re-planning to construct proper planning and monitor the action of students.
Among the contents of a lesson which are taught to the students, the total contents of a lesson are composed of the network of the main objectives of instructions that are relatively independent each other.
Lesson plan presents the evaluation problem and the instructional material of instructional unit, decided by the

curriculum planning to students in the proper level. The Instructional strategy module offers students the instructional material on the instruction unit and the evaluation problem by means of the method divided by the curriculum planning.
The gradual instruction objective must be created by considering the student level that has acquired the degree of difficulty of instruction unit and students' records obtained previously. For an efficient instruction, problem presentation order must be planned dynamically by according to the students' level. The instructional strategy module can create dynamically the problem about the concept learning and the discrimination learning using the CN. Also instructional strategy module can dynamically limit the number of links which the student can select, according to the level of each student. This module have functions which provide the students for advice when the students refer the irrelevant to the present learning content frequently or when disorientation problem occurs.

3.2 Activity Managing Modules

In this section, we design session managing module for providing time dependent group activities for synchronous learning/training. Table 2 defines operations for it.

Table 2 Synchronous learning/training operations

Operations	Functions
Basic Operations	Create Group
	Destroy Group
Group Management Operations	Join Group
	Leave Group
	Manage Applications
	Manage Time Event
	Control Token
	Manage Group Context
Data Transmission Operation	Support Unicast/Multicast
Information Management Operation	Manage and Retrieve User/Group Information

Figure 3 stands out session managing module configuration.

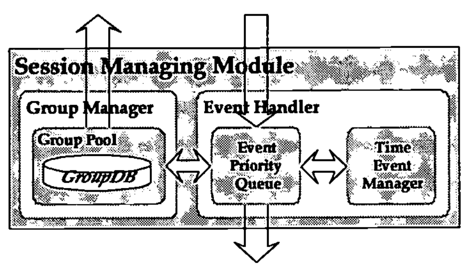

Figure 3. Sesssion Managing Module

Group manager creates groups as response for user requests, and manages them into group pool. Events caused at each group are sent to event handler, and processed using group managing interface.

3.2.1 Event Handler

Information sent to event handler consists of event data and consumer information. This information is managed as FIFO structure. Time event manager provides time dependent group activities. The creator can set lifetime of group, in this case, a group whose lifetime ended closed automatically. This facility is usable when lecturing has time dependency in educational system.
Time event manager manages information per group unit. Time event service process time event defined by user. When predefined event caused, it send it to group manager.

3.2.2 Group Manager

Group manager manages group context that consists of students information, operates for interaction among students. Group context includes student information who participate group currently, lecturer's information. Group manager maintains context recently processed event. When new event, such as participate and leave, caused context switching to appropriate context. When context switching caused, it notifies students of that case using event handler.

User can play a role of "Group Member" or "Inspector" and lecturer has a "Group Chairman" role. Lecturer as group creator has some privileges. Lecturer can give roles to students, close group oppressively, modify and manage group information.
A student must own token when transmit data to other students. When a lecturer requires token, group manager give token to lecturer immediately. But when a student asks token, group manager sends that request to the lecturer and then the lecturer arranges that. During context switching, such as changing token owner, participate or leave, group manager sends that to event manager.
Group manager provides "SendMessageToAll" operation when a student sends message to all participants. Session manager invokes it and group manager sends real data consists of student identifier and message contents using event handler.

3.3 MHEG Engine on Client Side

In this section, we design MHEG engine that can support real time user interaction and standard multimedia representation. Figure 4 shows the MHEG engine configuration.

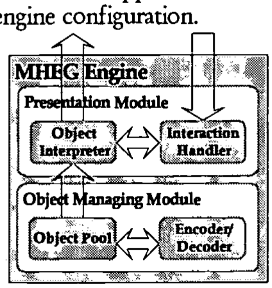

Figure 4 MHEG engine on client side

The engine consists of object managing module and presentation manager. The encoder and the decoder are based on class library. The class library serves converting between runtime objects and the MHEG objects. The presentation manager includes object interpreter and the interaction handler.

3.3.1 Object Managing Module

In our class library, we define the base class to inherit subclass. The MH5Object class, the base class, has method that can encode and decode one BER(Basic Encoding Rule) item. Each member variable of the MH5Object class is mapped into octets of the BER. The MH5Object class has methods for processing octets. It decodes the BER items, and provides decoded information to child classes. It also encodes information, which child classes specify, to the BER.
The root class is parent class of all other MHEG classes. The root class has an identifier of the application class. The group class includes the action object that must be executed after the MHEG application activated. Users can decode the application object by invoking member method. During encoding of the application object, we must add the BER lengths of lower level objects to length octet of higher level object. Thus, we need two encoding phases.
The scene class group defines the ingredient classes activated simultaneously. Unlike the application class, the scene class includes member variables that are required for presentation such as position and size. But, encoding and decoding of the scene object is same as them of application class.

3.3.2 Presentation Manager

The object interpreter analyzes internal object from decoder, converts them to object lists, and then stores in the object pool. The internal object from decoder is a tree-like structure whose root is the application class. The object handler extracts behaviors of presentable objects, and relocates objects.
When the object interpreter converts objects, we use temporal and spatial information. Since objects are relocated in accordance with spatial information, spatial synchronization and simple temporal synchronization in list structure are accomplished. The object pool contains lists of internal objects.
The purpose of interaction classes, such as hypertext, entry field, button, and slider, is supporting interaction with users. The interaction handler gathers and processes user inputs and events from presentable objects. The interaction handler analyzes transmitted events, and selects action objects. After that, it analyzes those action objects, and sends appropriate messages to message handling routine. Each interaction requires an action that selects certain object or modifies one or more objects.
All input has theirs own type in accordance with the interaction classes. The interaction classes are divided into real-time interaction classes and non real-time interaction classes. Table 3 shows types of user input for each MHEG-5 user interaction class.

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Table 3 Types of user input

Class	User Input	Data Type	Processing Type
Hypertext	Select/not	Boolean	real-time
Entry Field	Text String	String	non real-time
Push Button	Click/ Not	Boolean	real-time
Radio Button	Press/Release	Boolean	non real-time
Hot Spot	X, Y Position	Integer pair	real-time/ non real-time
Slider	Value	Integer	real-time

Link class consists of link condition and link effect. Link condition is a condition that invokes a link operation. It can be a combination of other conditions. Link effect is an action list that is executed when a link operates. Link effect consists of event source and event data. Event data is a user interaction class that causes an event for link operation. The interaction handler compares event data to user input. If this comparison returns true, the interaction handler executes actions specified in defined condition. Link effect is to be an elementary action or action list. Action list can include an action list. In case of this, action size, the whole size of action list, is required. Action targets, which are modified or selected by each action, are also required.

4. Conclusion and Future Work

We design multimedia system that has intelligent education capabilities on the Web. Our system has several advantages than legacy systems on the Web. We provide individual learning facilities using linguistic variables and fuzzy logic. And we provide more interactivities using MHEG standard. We can distribute educational system on the Web using CORBA. Our system is flexible for distance learning and training that requires more specific and dedicated user interaction.
Of course, We consider introduce XML to our system for multimedia representation on the Web. It accomplished, we can provide more generalized education features on the Web.

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Making a Case for Distributed Performance Support

Philip Barker
Human-Computer Interaction Laboratory
University of Teesside
Middlesbrough, United Kingdom
Email: Philip.Barker@tees.ac.uk

Nigel Beacham
Department of Civil & Building Engineering
Loughborough University
Loughborough, United Kingdom
Email: N.Beacham@lboro.ac.uk

Abstract: A performance support system provides a mechanism by which human skill levels within a particular task domain can be improved. This paper discusses the growing importance of distributed performance support systems and their use within the context of creating a 'learning organisation'. The design and development of a distributed performance support system called 'CLASS' is described. Its use as a performance tool is then compared with conventional approaches to aid provision within the context of creating supportive environments to facilitate the use of computer-assisted learning within an organisational framework.

1. Introduction

In their day to day activities, human beings are often required to perform a wide range of different tasks and jobs. These tasks vary quite considerably in their complexity. The successful execution of many of the more complex tasks often requires the use of some sort of tool, aiding facility or performance support system (PSS). The basic rationale underlying the use of a PSS is that individuals or groups of people (working together on a common project) are provided with appropriate tools and techniques to support the tasks that they have to perform. According to Barker and Hudson (1998), four major objectives of a performance support system are: (1) to achieve increases in productivity; (2) to improve the overall quality of task/job execution; (3) to improve the overall quality of the environments in which people work; and (4), from a human perspective, to reduce the complexity of the processes involved in executing a task.

Simple examples of performance support tools include: a typewriter, a telephone, a bicycle and an automobile. Increasingly, computer-based resources are being used to implement performance support systems. An electronic performance support system (EPSS) is therefore a facility which uses various types of computer technology to realise each of the four previously listed objectives within a given working environment or problem solving domain. Software packages such as word-processing systems and spreadsheets provide a good example of computer-based performance support systems.

Naturally, a fundamental requirement of an EPSS is that it should increase its users' on-the-job performance within a given task domain. This usually involves improving skill levels, reducing task complexity and/or providing appropriate training. These requirements can be achieved in two basic ways. First, through the provision of 'automation aids'; and, second, by providing various mechanisms to support 'on-the-job', 'just-in-time' (JIT) training which will enable users of any given system to 'learn as they do'. This latter requirement is an important aspect of building a 'learning organisation' (Lassey, 1998).

According to Malhotra (1996), a learning organisation is one which has *'an ingrained philosophy for anticipating, reacting and responding to change, complexity and uncertainty'*. Because organisations must adapt dynamically to the forces generated by change agents, ongoing learning and training activities are a fundamental requirement to their success. As has been discussed elsewhere (Gery, 1991; Beacham, 1998; Barker, van Schaik and Hudson, 1998), performance support systems are one way of realising this requirement within an organisational context.

Many of the early developments in EPSS have been described by Gery (1991), McGraw (1994), Varnadoe and Barron (1994), Raybould (1995), Banerji (1995) and Barker (1995a). Currently, there are two important directions of development for EPSS facilities. First, the creation of integrated toolsets that are able to meet the performance support needs of particular application domains (Barker and Hudson, 1998; Hudson, 1998); and second, a growing requirement to facilitate group working at a distance through the incorporation of network technology and the principles of distributred computing environments (Beacham, 1998). Indeed, the advent of relatively low-cost network technologies and the widespread availability of facilities such as the Internet and the World Wide Web has meant that performance support systems can now become highly distributed in nature - that is, different components can reside (or be replicated) at, and be accessed from, different geographical locations.

As far as this paper is concerned, we therefore regard a distributed performance support system (DPSS) as an integrated and globally accessible collection of electronic tools and data that can be used (as and when required) at particular points of need (within a workgroup or an organisation) in order to improve human performance within a given task domain. Because of their future importance as a resource for developing learning organisations, the remainder of this paper describes and discusses the evolution and future potential utility of distributed performance support systems. The design and construction of a single-site, multiple-server distributed performance support facility called CLASS ('Computer Learning and Support System') is then described and an outline is given of some the ways in which we have been using it. An attempt has been made to measure the potential utility of the system from the perspective of supporting its end-users' use of computer-assisted learning (CAL) packages. The findings from this work are briefly reviewed.

2. Case Study - The CLASS Facility

This section of the paper briefly discusses the background to the DPSS work that we have recently been undertaking. The implementation of the CLASS facility is then outlined. Finally, a description is given of the ways in which we have been using CLASS to support computer-assisted learning (CAL) and computer-based training (CBT) within the context of a learning organisation.

2.1 Background

Some of our early work in developing EPSS facilities has been described by Banerji (1995) and Barker (1995a; 1995b). Banerji showed how the performance of students using a file transfer program (kermit) could be improved through the provision of PC-based, online help and interactive aiding and training facilities. Similarly, Barker (1995b) has shown how the emerging principles of performance support can be used to apply EPSS techniques to the design and development of integrated support tools for use by students and staff in an academic setting within a university environment. Each of these applications involved the development of stand-alone EPSS tools. Our first attempt at building a distributed performance support system involved using a computer network system (the Internet) in order to access different forms of subject expertise that resided at different geographical locations (Barker, Richards and Banerji, 1994). This work has recently been extended and enhanced through the use of 'mobile computing' environments (Barker, 1996)

Many of the presently available distributed performance support systems that are now in use have evolved from conventional stand-alone EPSS facilities (such as those described above) in two basic ways. First, by providing 'dial-in' access; second, by implementing systems that can be shared in an in-house fashion through the use of local area networks. Current research in this area now seeks to incorporate activities of this sort within a more holistic approach that also involves the utilisation of global trans-world networks such as the Internet and World Wide Web.

In an attempt to rationalise activity in this area, we have proposed a DPSS taxonomy that incorporates two basic classification dimensions: first, the number of information servers that are involved; and second, the number of interlinked sites that make up the network topology. These dimensions permit a basic, four-class taxonomy to be proposed (Beacham, 1998). The classes within this taxonomy are: single-site, single-server; multiple-site, single-server; single-site, multiple-server; and multiple-site, multiple-server. The CLASS facility, that is described in the following section, is an example of a single-site, multiple-server system.

2.2 Implementing CLASS

The development of CLASS took place in three stages. The first stage involved conducting a needs analysis. Subsequently, in the second stage, a prototype system was built which was used for formative evaluation purposes. In the third stage, the prototype system was augmented and expanded into an operational DPSS. The needs analysis and implementation rationale are briefly described below.

The Needs Analysis

The needs analysis was undertaken within the School of Business and Management (SBM) at the University of Teesside in the UK. Its main aims were: (1) to identify the main limitations (if any) of current course provision within the SBM; and (2) to explore how CAL and PSS techniques might be used to make any improvements that were thought to be necessary. Both staff (teaching, research and administrative) and student (full-time and part-time) perspectives were studied using questionnaire-based techniques. In some situations, 'follow up' interviews were conducted in order to clarify issues that were not clear or in order to obtain more information about particular aspects of the study.

The results of the SBM needs analysis were compared with two other related surveys (one internal and one external) in order to look for similarities and trends. The internal (campus-wide) study was conducted by the University of Teesside's Library and Information Service (as part of its forward planning activities). The external survey was obtained from another UK university. As is discussed elsewhere (Beacham, 1998), the findings from both of these other surveys supported many of the findings of the SBM needs analysis.

Implementation Rationale

The findings from the needs analysis were used to 'steer' the design of the CLASS facility and also set priorities with respect to the order in which computer-based resources and online facilities were created and made available. As was mentioned above, the initial design and development strategy involved building a prototype system. This was based on the use of an in-house intranet facility and incorporated a virtual university metaphor (Barker, 1999). This allowed staff and students to use virtual offices, a virtual library and virtual classrooms. HTML (Version 4) was used as the development language and Netscape Navigator (Version 4) was used as the access and delivery vehicle. Extended interactivity within the system was achieved through the use of CGI scripting techniques, JavaScript and Java applets. Appropriate use was also made of 'helper' applications (primarily for Microsoft's PowerPoint, Word and Excel packages) and Netscape 'plug-

2.3 Using CLASS for Performance Support

This section of the paper briefly describes the main ways in which the CLASS facility has been used to support teaching, learning and administration activities within the SBM at the University of Teesside.

Once an intranet facility had been created within the SBM it became possible to use it to store, retrieve, deliver and maintain virtually all course-related documentation. By dispensing with 'paper' and providing electronic access to these materials through computer terminals, the productivity of staff and students increased substantially - in terms of ease of access to course-related information and the ease with which this could be modified and updated.

The basic rationale underlying our use of CLASS for the support of teaching and learning activities is similar to that outlined by Barker et al (1995) in their description of the use of a global performance support system for students and staff. However, the CLASS system goes much further, in that, it embeds a virtual university metaphor and allows various approaches to both synchronous and asynchronous teaching and learning activities. Some of the facilities that CLASS contains, or provides access to, include: online lecture notes; copies of lecture presentations (PowerPoint); problems and worked solutions; course-related CAL/CBT packages; details of project work; tutorial and workshop descriptions; email facilities; class schedules; conferencing facilities; electronic notice-boards; automatic marking of certain types of submitted work; and automated student self-assessment of progress. Although CLASS is by no means in its final form, the feedback that we have received with respects to its acceptance and utility provides significant motivation for its ongoing development. This feedback is discussed in the following section.

3. Evaluating Class

An extensive evaluation of the CLASS facility has been undertaken. Details of this are presented elsewhere (Beacham, 1998). This section of the paper provides an overview of the methods used and the results obtained.

3.1 Methodology

A four-step evaluation strategy was used. This involved assessing both staff's and students' attitudes towards four different approaches to the provision of support to facilitate the teaching and learning of a particular topic ***X*** within a given module ***Y*** of a degree course ***Z***. The four situations that were considered were: (1) minimal support; (2) conventional support with 'add-on' CAL; (3) conventional support with 'ownership' of CAL; and (4) the use of a DPSS. In case (1), a CAL package was used to teach the topic (X); no lectures were given and tutorials were organised in an ad-hoc basis, as and when they were needed. Case (2) involved a conventional teaching situation (with scheduled lectures and tutorials on topic X) with students using the CAL package as an 'add on' extra. Resource-wise, case (3) was similar to case (2) but involved re-organising the way in which the CAL package was used; in this approach the CAL program was used (by the lecturer) as a central resource (for demonstration and illustration purposes within lectures, tutorials and workshops) and by students (for the support of self-study activities). Case (4) was the same as case (3) but with the addition of a purpose-built DPSS facility (CLASS) to augment the course Z (in general) and the teaching of the module Y and topic X (in particular).

In each of the evaluation scenarios described above, questionnaires were used in order to obtain the opinions of staff and students with respect to pedagogic, technical, logistic, organisational and resource-based issues. Some of the results that were obtained are summarised in the following section.

3.2 Results

As was mentioned above, four basic evaluation scenarios were employed. These were used to gather feedback about the different types of support environment (for using CAL packages) and, in particular, the potential utility of the CLASS facility as a support mechanism for teaching and learning within an organisational context. Based on the various types of questionnaire that were employed in the evaluation, a set of six 'derived' attributes were identified as a basis for comparing the different modes of support. The six attributes that were used are listed in (Tab. 1) along with the attribute values that have been derived from the questionnaire data. Overall, 330 student volunteers participated in the evaluation process. All students were involved in studying the topic of '*Marginal Costing*' as part of a degree module entitled '*Introduction to Financial Decision Making*' (the total enrolment for this course at the time the evaluations were conducted was 549). The distribution of students over the different evaluation scenarios listed in (Tab. 1) was as follows: Case 1 (61); Case 2 (183); Case 3 (43); and Case 4 (43). Some members of staff also participated in two of the evaluation scenarios (Cases 3 and 4). However, the data derived from the staff questionnaires is not included in (Tab. 1); this is presented and discussed elsewhere (Beacham, 1998).

Attribute Assessed	Case 1 (Minimal)	Case 2 (Add-on)	Case 3 (Ownership)	Case 4 (CLASS)
Knowledge of topic after using CBL package	Low	Moderate	Very Low	High
Like using the CBL package	Very Low	Low	High	High
Factors limiting use (difficulty with package)	Low	Low	High	Very Low
CBL package easy to use	Low	Very Low	High	High
Environment contains features that are helpful	Very Low	Low	High	Very High
The range of sources available for practice	Very Low	Low	Low	High

Table 1: Summary of Evaluation Results

3.3 Discussion

As might be expected, the results shown in (Tab. 1) clearly reflect the apparent superiority of Cases 3 and 4 over Cases 1 and 2. Undoubtedly, this arises because the 'ownership' model of CAL usage and the integrated holistic approach provided by a DPSS (CLASS) each embed much richer teaching and learning strategies. Having said this, inspection of the results in row 1 of (Tab. 1) suggests that the topic knowledge transferred by CAL techniques using Case 3 seems to be less than that which takes place in Cases 1 and 2. This is indeed surprising since we would have anticipated that the knowledge transfer achieved using this approach to CAL package utilisation would be comparable with that observed in Case 4. We believe one possible reason for this anomaly is that the high level of knowledge transfer that took place in lectures and tutorials (using the 'ownership' model) reduced the need for students to make additional use of the CAL package themselves as a self-study resource.

As can be seen from (Tab. 1), the only approach which scores positively in all six attributes is Case 4. These results reflect that students felt that there were particular benefits to be gained by embedding a CAL package within the CLASS facility; namely, it was easier to use, it reduced the amount of difficulty experienced and provided a large number of sources from which to obtain information and practice skills. Bearing this in mind, we believe that these findings make a sound case for the more extensive use of the DPSS approach to the provision of aiding and support facilities.

4. Conclusion

Computers and electronic communications technologies are increasingly being used to provide mechanisms for the support of training, teaching and learning. These technologies make it possible to augment conventional approaches to instruction and, more importantly, provide mechanisms to facilitate 'education on demand' in a variety of different situations and contexts - such as, in the home, in the workplace, in libraries and in colleges. They also provide facilities for developing new approaches to skill and knowledge acquisition in the workplace through techniques such as 'on-the-job' learning and 'just-in-time' training. Within the context of creating 'learning organisations', an integrated, holistic approach to the provision of access to teaching/learning resources is now needed. We believe that this requirement can be fulfilled through the provision of distributed performance support systems similar to the CLASS facility that has been described in this paper.

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Deployment Scenarios of DVEs in Education

C. Bouras
Computer Technology Institute, Patras, Greece, bouras@cti.gr

V. Kapoulas
Computer Technology Institute, Patras, Greece, kapoulas@cti.gr

A. Koubek
Technikum Joanneum, Graz, Austria, koubek@fh-joanneum.at

H. Mayer
Joanneum Research, Graz, Austria, harald.mayer@joanneum.ac.at

Abstract: DVEs, along with the Internet in general, offer a number of attractive features for the education sector. However deployment in traditional educational environments, such as secondary schools, has not been achieved on a noticeable scale so far. In this contribution, we discuss technical and pedagogical issues, and specifically define possible scenarios of how this technology can be introduced to the school sector in a sustainable way.

Introduction

An accelerating factor in the use of the Information and Communication Technologies (ICT) is the recent advances in the fields of multimedia and telematics applications. Multimedia and telematics comprise the hard core of ICT. Multimedia can be considered as the combination of any two or more different media types (text, graphics, images, audio, and video). Furthermore, hypertext and hypermedia technology uses hyperlinks in order to represent in a structured way information that could be in various media types. This technology gives the user the ability to explore the information in a non-linear format that changes dynamically according to the user's choices. Additionally, virtual reality applications offer 3D interactive environments that can simulate real-life events and have great potential for educational purposes.

On the pedagogical side, new learning methods arise from the use of multimedia and telematics applications. These methods focus on the learner and allow an active, creative construction of his/her knowledge. New pedagogical models exploiting the potential of these technologies are emerging and new information or knowledge sources are now at the learner's fingertips. Informal access to knowledge through museums, science centres, libraries or browsing on the Internet is playing an increasing role in the learning process, but its impact is far from being understood. On the content side, the subject matters as the learning goals themselves are rapidly changing. On the software side, software agent technology enhances learning by providing intelligent assistance to learners in situations where direct manipulation interfaces are insufficient. Virtual reality techniques reduce the cognitive load in the use of some applications and thereby improve learning efficiency.

Today, most countries consider multimedia and telematics technologies as an educational tool and are trying to incorporate them actively in their curricula. The main concept is that the use of these technologies can significantly contribute to the educational process, supporting in parallel the role of the teacher.

Furthermore, many pedagogues have stated that multimedia and telematics applications could improve the quality of the offered education, because they can simulate many basic models of the learning process and the natural proceeding in which man assimilates knowledge. In particular, telematics technologies can simulate the learning by exploring and the incidental learning, while they could be used for the immediate access of learning materials and the collaboration among students.

Distributed Virtual Environments

A simple definition of a Virtual Environment (VE) is a computer-generated simulation, and the term usually implies the use of 3D computer graphics in the interface. VEs can in addition be multi-user, supporting multiple interacting users, and distributed, running on several computers connected by a network. It has become common to refer to a VE with both these additional properties as a DVE (Distributed Virtual Environment). A Distributed Virtual Environment (DVE) allows a group of geographically separated users to interact in real time. The environment in which a DVE user is immersed is three-dimensional to the eye and ear. Moving in the environment changes the userš visual and auditory perspective. Unlike a video conferencing system (where an attendeeš screen shows other attendees in their own video-conferencing rooms), DVE users assemble in a virtual world - they are all seen, for example, seated together around a conference table in one room, or walking together in a virtual building. Every user of a DVE appears in the computer environment as an avatar - either a customised graphical representation, a video of the user, or some combination of both -, which he or she controls. The user, besides interacting with one another, also deals with one or more computer simulations. While in use, a DVE can change continually, in every aspect. Further, a DVE can grow dynamically by accepting contributions of objects and structures from many sources. On one hand, interactivity is a basic requirement of all virtual environments. On the other hand, distributed virtual worlds require a certain level of persistence to achieve the impression of a single shared world. Persistence is realised by distributing and synchronising user input as well as user independent behaviour.

The role of DVEs in education

Implementations of DVEs, along with the Internet in general, offer a number of attractive features for the education sector:

- They may have cross-platform compatibility.
- Software for creating DVEs content can be downloaded for free.
- As some DVEs sit upon the World Wide Web, existing student knowledge is applicable, easing use.
- Pupils are used to DVEs from popular games, and expect immersion from innovative computer applications.

DVEs in education can be used in various ways but the most promising ones are either as mediums for education and research or as collaborative mediums.

As a medium for education & research

DVEs are being proposed as a means to facilitate both teaching and research in the educational sector. Indeed this is the most obvious role for DVEs. Three-dimensional content can be created and distributed to oneš own students, or made more widely available to learners across the globe. There are plenty of obvious applications for educational simulators in a number of fields: physics, planetary exploration, archaeology, biology, and chemistry all can benefit greatly from better visualisation technologies. The point of these systems is not necessarily the amount of things that can be done with them but the fact that students can have the power to create them on their own and can find it fun and motivating to do so. Any textbook or course materials that have 3-D graphics, such as architecture and engineering, may benefit from DVEs. If the course materials, or the research papers, require multiple drawing of a 3D object or space, then clearly DVEs will give benefits.

As a collaborative medium

One of the longer-term opportunities, but possibly the most exciting, lies in the educational use of the shared spaces for distance teaching and project collaboration. The communicative worlds, similar to those described above, would allow for students and stuff to engage in distributed meetings, seminars and tutorials. A number of trials using these existing technologies are being tried.

Collaborative virtual environments provide gathering grounds for new communities and types of interactions, and they give people a voice like they have never had before. We can share experiences and visions and learn to understand the other persons point of view. We can attend concerts, act in plays, and attend classes with an international audience. As long as people have something to say to somebody else, they can say it online.

Virtual European School

VES is a European project in the Educational Multimedia Sector, aiming to build up a comprehensive resource on teaching and learning material for secondary schools (pupils 10-19). The offer of the final VES system (ready in February 2000) will contain multimedia material, CBT products, and also additional background materials, such as passages from schoolbooks, or Internet resources. A major strength of VES is that a large consortium of educational publishers supports it. Over 20 publishers from 4 countries participate in VES providing content and designing the system in such a way, that VES fits into the working process of publishing houses. Therefore a smooth work-flow for delivery of material is guaranteed, and VES has the potential to become in short time one of the primary providers of on-line material in the major participating countries, that is Austria, Italy and Greece. However, in order to become a successful system, VES not only needs to fit the needs of publishers, but also the needs of its end-users, that is pupils and teachers in their role as multipliers. In order to integrate schools in the design process, VES has established a continuous feedback process in each of the three VES countries. In each country a regional school-network is collaborating with VES. Ideas are brought to the schools for evaluation and feedback is integrated into the design process. VES will be turned into a commercial system in the beginning of 2000. Billing and Copyright issues need to be implemented in a sustainable way. These topics will be essential for the success of the exploitation strategy of VES.

Deployment scenarios of DVEs within VES

Pedagogical issues

Using innovative technologies, VES aims to support new ways of learning. Providing students an access to the whole base of learning material gives them the opportunity to become more autonomous in their learning process. Students will no longer rely on only one source of information, but will be able to compare different sources and find additional information on their subject.

A typical example could be a DVE discussion platform on the various parliamentary systems in Europe. The DVE environment could provide the data, but the pupils can discuss on which voting or representation rules seem the most effective and democratic ones. For younger pupils a DVE on different climates throughout Europe would be more appropriate. A teacher can be present in such an environment, monitoring the cross-national discussions, and intervening only on specific open questions.

The key feature in these applications is immersion. DVEs can give a three-dimensional realistic view of an environment or situation. Therefore navigating within a DVE, learning is an active, explorative process. Views of the environment are individual, since persons are located in different positions in the environment

Scenarios of usage

Using DVEs in education encounters several obstacles. First and most important the limited bandwidth with which most schools are connected to the information infrastructure. However also more soft facts, as the missing of VR content, and the very limited experience of teachers with this sort of technology, need to be taken in account, when one designs a learning platform based on DVEs.

Within VES this problem was tackled, by defining several strategies, how to introduce DVEs to the target groups. More specifically there are three main scenarios envisaged:

- DVEs as Web site entry and navigation tool: A DVE used as main VES user interface, which leads, through objects allocated into that world, to other VES functionalities, such as search, compose or retrieve

content. These functionalities in a first development step can be traditional functions (chat, newsgroup, search, etc.).
- DVEs as learning units: VES will contain many individual learning units from different content providers. Some of those learning units could be DVEs, as fixed virtual worlds where objects in those worlds could be linked to specific content objects (such as texts, videos, and simulations). Further of course in such environments VR objects are envisaged. Participants can interact with objects, and gain access to the relevant learning units.
- DVEs as general content user interface: As a third development step, it is planned to provide a DVE tool set to teachers, containing several model worlds and a database of 3D objects to be allocated into these worlds by the teachers.

In sequel we present these scenarios in more detail.

DVEs as Web site entry and navigation tool

The Virtual Learning Centre represents an attempt to build a learning environment combining real life situations, educational principles, virtual reality features and WWW technology features. The development scenario foresees, that in a first stage the Centre, will be merely an entry point to traditional functionalities, such as search, browse content etc. in a two dimensional interface.

However the aim is to evolve this entry point to a fully functional Virtual Learning Centre. Within this Centre the participant will have access through familiar objects to typical functions. One example abstraction that we use for representing the stored material of the VES system is a building of an exhibition centre, where publishers have their own place to display their educational products. The centre is organised in halls, or thematic units. Each hall is organised around a learning subject, like natural sciences, art and culture, technology, foreign languages and others. Furthermore, each hall that represents a specific subject is divided in rooms, where each room represents a different learning age.

Every room of the centre offers different material, but the structure of the room is the same for all. In every room, there are kiosks that represent the publishers that put material in the VES system. Every publisher has its own kiosk in every room, where it displays the material that belongs to him. In the kiosks there are entities that represent the content material of that publisher. For example, a user can go to a kiosk, select a book, open it, see the metadata information about it that is stored in the database of the VES system and if he is interested in this item then he can view or download the relative content unit. There is physical representation of the most recently added items in the database, while the older items are inserted in a list, which the user can browse and select to view any of these. In this way there is no need to have physical representation for every content unit that is stored.

Having this hierarchical structure, the DVE environment becomes very easy for the user to navigate in it and find the material that he wants. In addition, the user can get used to the virtual environment after some visits and not get lost in it. Every room of the centre is a separate small file of a virtual world, reducing thus downloads times, and the user can go from one room to another through appropriate portals.

The Virtual Learning Centre comprises a number of other spaces characterised by function. There is an information centre where the user can get available information about the environment, the rooms and how to get there, latest news and others. Furthermore, there exist a conference room where predefined lectures, presentations, seminars and other events take place. As the VES system expands there will be and other rooms with specific functionality.

DVEs as learning units

DVEs are not at all common in the educational sector, and especially educational publishers have hardly any experience in this field. Building a comprehensive resource on learning material, based on VR techniques, is currently not feasible.

In the case of content production, it is possible to circumvent this problem by starting to develop single DVE content units, where a clear educational added value can be seen, and where content providers (in the case of VES publishers) are sustained by VR specialists in the creation of such worlds.

In the VES context these worlds are planned to be non-populated, but rather targeted at immersion properties of DVEs. An example could be the simulation of sewage treatment plant, where all the work cycles are shown, and the reaction of the system is simulated when different mechanism are being used. Limiting the DVEs to this scope not only facilitates the production and technical issues, but also gives a controllable way for teachers not used to this technology to adopt virtual environments in classroom teaching.

Within VES this development step is certainly not seen as an end-point, but rather as a first step towards deployment in school use. Once teachers, as multipliers get acquainted with this novel form of content, more interactive and open environments will be inserted.

DVEs made from collections of building blocks

The most advanced scenario, in terms of user integration is the one of DVEs as general content user interface. In this case it is envisaged that all content is allocated into virtual worlds. The working scheme would foresee that publishers and VR experts create an abundant database of basic DVEs and base objects, which can populate the environments.

An example of such a unit could be a VR timeline. The time-line indicating the years (or centuries) would present the basic DVE, while the base objects would be for example figures (e.g. an image of Napoleon), scenes and movies (a short video on life-style during French revolution period), but also more basic objects as dictionaries, notice boards, etc. Teachers would then take the empty world and populate it with the objects suiting their needs, associating to the base objects functions defined by them.

A user analysis performed within the project VES has shown that this deployment of DVEs is currently not sustainable in most educational settings. Therefore it is necessary to start out with the less advanced scenarios, in order to acquaint teachers to the new technology.

Design Issues

The design of a Virtual Learning Environment can be based on the idea of an exhibition centre, where the educational material is organised hierarchically according to a universal or subject-specific classification scheme for educational content. The exhibition centre is organised in thematic halls," each of them organised around a learning subject, such as mathematics, science, geography, art and culture, foreign languages, etc. Each thematic hall"representing a specific learning subject is further divided into rooms representing the subdivisions of each subject according to the classification scheme. Moreover, at the bottom level of the hierarchy there exist rooms representing educational content for different learning ages.

In order to have a user-friendly, integrated, and interactive user interface, the 3D environment of the Virtual Learning Environment can be combined with several HTML frames, each of them having its own functionality. Thus, one frame is used for embedding the Virtual Learning Environment, another is used for displaying status messages to the user and the rest display a console of buttons for interaction with the Virtual World. For example, there always exists a plan view representing the current users position at the Virtual Learning Environment and facilitating the navigation through different rooms. Also, the user can switch viewpoints, take predefined paths, or view certain simulations of specific tasks in the world. Finally, the content units that the user selects to view are displayed in a separate window so that the main console is always visible, avoiding in this way continuous back and forward actions.

Implementation Issues

An approach is to use VRML for the implementation of the Virtual Learning Environment. VRML is an acronym for the Virtual Reality Modelling Language. The aim of VRML is to bring to the Internet the advantages of 3D spaces, known as VRML worlds whether they comprise environments or single objects. The ISO/IEC 14772-1 international standard specifies the current version VRML 97. VRML offers a number of attractive features for presenting educational material including ease of use and cross-platform compatibility.

Another approach for the implementation of the Virtual Learning Environment is to use Superscapes VRT, which is an application for creating 3D environments. The file format of VRT worlds is SVR, which is a compressed binary file that contains all the geometry, textures, sounds and behaviours needed for the interactive 3D world, in a highly compact and encoded form, giving short download times and rapid set-up times. The 3D browser that displays VRT worlds is called Viscape and it is freely available. VRT has also a purpose-built behavioural control language, called Superscape Control Language (SCL) which is based on the C language.

In order to add the capability of, more than one, users accessing the same Virtual Environment at the same time and to create a Distributed Virtual Environment (DVE), a communication platform is needed for performing the interaction between the different users across the network. A DVE provides the users with access to a shared 3D environment. All participants are presented with the illusion of being located in the same place, such as in the same room, building, or terrain. That shared environment represents a common location within which other interactions can take place. The shared environment presents the same characteristics to all the participants. For example, all the participants could get the same sense of the temperature and weather, as well as the acoustics. Additionally, DVEs provides some way of communication between the participants by means of typed text, voice, etc. A DVE system consists of four basic components that work together to provide the sense of immersion among users at different sites. These are a graphic display, communication and control devices, a processing system, and a data network.

The main commercial platform for implementing DVEs from a VRML or a SVR world is the Blaxxun Community Server. The Blaxxun Community Server is a multi-user server that supports the operation, administration and usage tracking of virtual worlds that many users can inhabit simultaneously. It is an open system that supports all the relevant standards: HTML, VRML, Java, vCard, ActiveX, OCX, Direct3D and OpenGL to enable 3D multi-user interaction and it works together with the Blaxxun Community Clients.

Conclusions

The construction of Distributed Virtual Environments should be seen as a design problem in the broadest sense. VR projects with an educational remit should recall at all times the criteria of educational effectiveness. The drawbacks as well as the advantages of various aspects should be evaluated, including the effects of concretising information, of appropriateness of spatial metaphors and of the interface. Regarding shared worlds, they should be investigated to support distance tutoring and research, but with caution to ensure that the social grouping effect of actual meeting is not lost.

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Designing Collaborative Distance Learning Environments for Complex Domains

J. Michael Spector
Educational Information Science & Technology, University of Bergen, Norway
Michael.Spector@ifi.uib.no

Barabara Wasson
Pedagogical Information Science, University of Bergen, Norway
Barabara.Wasson@ifi.uib.no

Pål I. Davidsen
System Dynamics Program, University of Bergen, Norway
Pal.Davidsen@ifi.uib.no

Abstract: Our aim is to describe and illustrate a theoretically based approach to the design of collaborative distance learning environments for complex domains. There is an obvious growth in the use of distributed, online learning environments. There is evidence to suggest that collaborative learning environments can be effective, especially when using advanced technology to support learning in and about complex domains. There is also an extensive body of research literature in the areas of situated cognition and problem-based learning that provides a theoretical perspective for the design of such learning environments. What is lacking is a clear articulation of design principles to guide the implementation of collaborative distance learning environments. We provide a description of such design principles, explicitly drawing on a socially-situated view of problem-based learning in technology-mediated environments. We conclude with a description of how this framework can be applied to the design of system dynamics based learning environments.

Introduction

Technology-based learning environments are growing in number and prevalence in spite of continuing debates in the academic literature with regard to their learning-effectiveness, impacts on organizations, and overall utility to society (Carter 1997, Clark 1994, Kozma 1994, Lengel 1997). There are many investigations into how people might learn using new technologies, and these studies are, in turn, causing much discussion with regard to foundational issues in learning theory and instructional design. One challenge is to make effective use of new technologies to support learning and instruction. It is our hope to provide a design framework for technology-mediated learning environments. This framework has implications for designing learning environments for complex systems. We proceed by briefly identifying and reviewing relevant theoretical perspectives. We then establish a unifying perspective with clear design implications in the context of these theories. This unifying perspective will then be used to describe our framework. We conclude with an illustration of the framework.

Theoretical Perspective

We begin by identifying relevant assumptions: (1) learning is a natural, human activity; (2) the unit of analysis for learning effectiveness is an individual human learner; and, (3) learners are rational. The prevalent research perspective is that instructional design is primarily a prescriptive enterprise forming a bridge between descriptive learning research and practical development of learning environments (Reigeluth 1983).

There is practical value in adopting this research perspective. By varying the instructional methods used in certain conditions, one can measure outcomes and study the effects of those methods on learning outcomes. If enough data is collected, one then hopes to be able to establish a strong argument for the desirability of a particular method given certain learning conditions, thus prescribing how one ought to design instruction to achieve desired outcomes. In this perspective, it is possible to identify how various types of learners engage in this process and then to take those differences into account in the design of instruction. Learners are rational in the sense that they are goal-driven, purposeful agents with the ability to identify and select reasonably efficient means to achieve goals. Typically, conditions are held constant and various interventions (instructional methods instantiated in particular learning environments) are investigated. Learning outcomes or effects are then measured on individuals.

Such a research paradigm has in fact produced many useful findings, so it should not be discounted. We refer to this as the atomistic perspective because it is characterized by an atomistic view of learning, both in terms of units of learning (very specific and discrete conditions, methods, and outcomes) and in terms of learners (typically focusing on individual learners). The atomistic perspective can be contrasted with what we call the integrated perspective (Spector 1995). The integrated perspective views learning as holistic and learners as members of a society or language community. The goals of a society or language community typically include a strong survival element, although this is quite often not made explicit. Living consists of working and learning, which are viewed as essentially collaborative efforts to achieve commonly held goals. From this perspective, individuals might manage to acquire extremely high levels of performance at particular tasks while the larger social group consistently falters. This would not count as effective learning from an integrated perspective.

Complex Domains

Complex systems can be depicted as a collection of inter-related items (e.g., stocks and flows in system dynamics), characterized by internal feedback mechanisms, nonlinearities, delays, and uncertainties (Sterman 1994). These systems typically exhibit dynamic behavior, especially in the sense that how they behave has an effect on the structure of the system, perhaps strengthening or changing the feedback mechanisms. This change in internal structure in turn has consequences for how the system will behave in the future (Davidsen 1994, 1996). Such complexity is difficult to understand, especially for newcomers to a complex domain.

Complex systems can be found in abundance at many different levels. Economics, ecology, epidemiology, project management, and training all typically involve complex, dynamic systems. People have difficulty in understanding and making good decisions about such systems (Dörner 1996). There are clearly individual exceptions, persons who somehow acquire a deep understanding of such systems. Typically, such deep understanding, characterized by effective decision making across a wide variety of changing conditions, takes years to acquire, and appears not to be easily acquired in spite of concentrated education and training efforts (Dreyfus & Dreyfus 1986). Why have we failed to improve our thinking skills in complex domains in spite of such persistent and serious efforts? In part, we have not fully understood relevant psychological and sociological factors. In part, we have not fully integrated relevant principles about human learning into design praxis.

People have difficulty in estimating the effects of accumulation over time, in predicting the effects of delays, and in calculating nonlinear outcomes (Sterman 1994). People tend to focus on local problems as opposed to whole systems, even when told that a holistic understanding is essential for solving particular problems. People become cynical and overlook possible solutions when initial attempts fail. People do not communicate effectively in crisis situations. People have difficulty inferring underlying system structures from externally viewed system behaviors (Dörner 1996).

We believe that instructional scientists have not fully understood the socially-situated learning perspective and its implications for human learning in and about complex systems. There is a great deal of discussion about situated, problem-based, and collaborative learning, but we are missing critical pieces of a design framework. Put differently, we believe that we lack a well-articulated design framework with sufficient detail to take us from a socially-situated, problem-based, collaborative learning perspective to the design of a particular learning environment for a particular subject domain. The closest such approach we find is cognitive apprenticeship (Collins 1991). We regard our work as an extension to that approach.

Situated Learning and Vygotsky's Cultural-historical Theory

The theoretical foundations for this effort come primarily from a socially-situated learning perspective (Lave 1988, Piaget 1970, Vygotsky 1978). Within this perspective, learning is viewed as an active process of knowledge construction in which learners are typically involved with other learners in authentic, problem-solving situations. The need to learn created by a realistic problem provides motivation, and interaction with other similarly immersed learners provides facilitation. We are favorably inclined to an attitude similar to Sfard's (1998) that emphasizes the need for both an acquisition metaphor (static knowledge objects with learners acquiring expertise) and a participation metaphor (dynamic knowledge objects with learners as active apprentices). Much higher order learning relies on knowledge and associated learning activities that might best be supported within the acquisition view. However, to progress beyond competent performance and become a proficient expert (Dreyfus & Dreyfus 1986), we believe that the participation metaphor with its emphasis on active learner participation in socially-situated and problem-oriented settings is crucial.

For Vygotsky (1978), human mental functions appear first as inter-individual and later as intra-individual. This process involves the use of socially developed tools. For Vygotsky, the unit of analysis for human activity and for human learning was the mediated action of an individual. This broadens the unit of analysis identified earlier from just the individual to include an artifact with which an individual interacts. Davydov (1988) developed a psychological theory of learning activity which focused on goal-oriented, collaborations within a social context. From this perspective, the aim of a learning activity is to teach study skills that enable learners to think on their own.

Collaborative Learning

Collaborative learning is based on the notions of *socially shared cognition* (Resnick, Levine & Teasley 1991), of *distributed cognition* (Salomon 1993), and of *jointly accomplished performance* (Pea 1993). In the latter, cognitive development is viewed as occurring though interactions between students, as well as between students and knowledgeable environments. Collaborative telelearning emphasizes collaborative interactions among students and between students and supporting actors in a distance learning environment (Wasson & Bourdeau 1998). Introducing collaboration into a telelearning situation raises new challenges related to the logistics and to the logistical support of collaboration. The majority of research into collaborative learning has focused on collaboration between physically present actors and has generally focused on whether and under what circumstances collaborative learning was more effective than individual learning. More recent efforts, however, have been directed towards a more process-oriented account of collaboration where the focus is on the role that variables such as group size, group composition, and communication paradigm play in mediating interactions. This is a clear indication that the unit of analysis has been appropriately enlarged beyond the individual learner.

We have now collected several design principles which form key features of a design framework, and we have shown their linkage to learning theory. These principles might be summarized as follows:

1. Provide support for the joint construction of knowledge objects and for the joint construction of problem solutions. This can be accomplished by providing learner-extensible databases, by providing learner-modifiable simulation models, by supporting learner-learner and learner-tutor collaboration in making changes and extensions to existing knowledge objects, and by supporting learner-learner and learner-tutor reflection on outcomes of those modifications.
2. Provide tools to support joint negotiation of alternatives. Commenting tools are a beginning. Allowing changes to be tested when appropriate is also important. It is especially important to allow learners to try out alternative simulation models, to observe results, and to support learner-learner and learner-tutor discussion and analysis of those results.
3. Provide both public and private feedback support mechanisms for learners while emphasizing to those intelligent agents providing feedback that it is important for learners to gradually improve their own ability to monitor and assess progress toward desired goals.

In short, this framework aims to support both individual work and collaborative activities, and it especially aims to support the development of collaborative learning communities.

Computer Supported Collaborative Learning (CSCL) & Telelearning

The important implications for CSCL that emerge from these theoretical foundations include a wide range of designs for computer-based learning environments, as well as the view that the computer is a mediating tool that needs to be seen in the context of the entire learning environment within which it will be used. That context includes the instructional setting, the presence or absence of a teacher, the role of teachers and tutors, the role of the learner and other learners, the curriculum, the organizational setting, etc.). Much contemporary research that falls under the umbrella term socio-cultural theory (e.g., Collins 1991) has been inspired by Vygotsky and his followers. CSCL requires thoughtful and careful design of learning scenarios and learning support. CSCL also requires technological design encompassing the telelearning environment configuration as well as the tools and services available.

The term *telelearning* is used to designate new forms of distance or of computer mediated learning, where the distance is not only distance in space or time, as in traditional distance learning, but distance in terms of culture and community, as well as distance in the mediation of learning activities and knowledge objects (Wasson & Bourdeau 1998). Distance learning evolved from an initial need to ensure equal access to education for all students. The most obvious feature of a distance learning setting is that students and teachers do not all meet at the same place or at the same time. Individual learning, individual tutoring and asynchronous communication are typical features of a distance learning situation, requiring extensive macro- and micro-instructional design, and a strong student support system. Variations of telelearning presence need to be taken into consideration, including the sense of telepresence in a virtual meeting, the sense of telepresence in interactions with rich multimedia environments, and the sense of telepresence in extensive human collaborations with online knowledge objects and virtual worlds (e.g., online microworlds).

A Design Framework for Collaborative Learning Environments

A relevant paradigm for the design of these learning environments can be found in the computer supported collaborative learning (CSCL) literature (Koschmann 1996). This paradigm focuses on the use of information and communications technology as a mediating tool within a collaborative framework (e.g., peer learning and tutoring, reciprocal teaching, project- or problem-based learning, simulations, games) of learning. This particular approach emphasizes an understanding of language, culture and other aspects of the social setting and can be traced in part to a socially-situated perspective of learning, as we have already indicated. While some suggest that these theories are not compatible, we suggest that they in fact provide an excellent theoretical framework for the design of online collaborative learning environments, especially for complex domains. The common and unifying notion of situated or shared cognition emphasizes the larger environment within which learning takes place; learning is viewed in part as entering into a *community of practice* with a shared language and understanding. The problem of establishing such a community of practice in distributed and online settings is a critical design aspect that has been poorly understood and not especially well implemented in practice.

The design methodology that we advocate is based on cognitive apprenticeship (Collins 1991), providing more learner support and facilitation for less experienced learners and gradually fading support and facilitation for more experienced learners. The learning setting is telelearning, as previously described. The overall learning approach is collaborative in nature, consistent with the theoretical foundations cited earlier. The specific view of collaboration is that tasks and activities should be realistically arranged and mediated in ways that naturally involve and recognize particular interests and skills of learners (Salomon 1993). That is to say that the collaborations should not be artificially enforced and that the sense of collaboration from the learner's perspective should be such that collaboration is viewed as necessary in order to complete the desired goals. In the marine bio-diversity example, students work in small groups of two and three and rely heavily on the assistance of graduate assistants and teachers to check their work. Nevertheless, they understand the significance of the activities in which they are engaged and recognize their contributions as valued and significant.

We conclude with an example to illustrate this theoretical framework. As we have already said, we do not believe that any large-scale, commercial learning environment has been designed with a systemic view of learning according to a theoretical perspective such as that presented here. Figure 1 is drawn from a learning environment designed according to this framework. Several such learning environments have been constructed and some data pertaining to learning effectiveness has been accumulated. That data suggest that this approach does promote learning and has been reported elsewhere (Spector 1998).

Exemplifying the Framework

We have thus far identified the following elements of an online learning environment for complex domains:

- Provide support for collaborative construction of components;

- Provide tools to support negotiation of alternatives;
- Provide both public and private feedback support mechanisms;
- Provide mechanisms to share and exchange information, objects, views, etc.;
- Facilitate a meaningful division of labor;
- Support joint, online thinking, commentary, etc.;
- Include meaningful learning scenarios;
- Design authentic problems and legitimate cases as the basis for learning activities;
- Take into account the entire learning environment;
- Support mediation among all the participants; and,
- Foster a sense of a collaborative learning community.

Figure 1 shows a screen from one version of a learning environment for resource management in large-scale instructional development projects. This screen shows that learners have multiple views of a complex domain. Consistent with our framework, this environment supports both learner-learner and learner-tutor interactions, as well as learner manipulation and modification of the underlying simulation, after learners have passed beyond the level of advanced beginner in this domain.

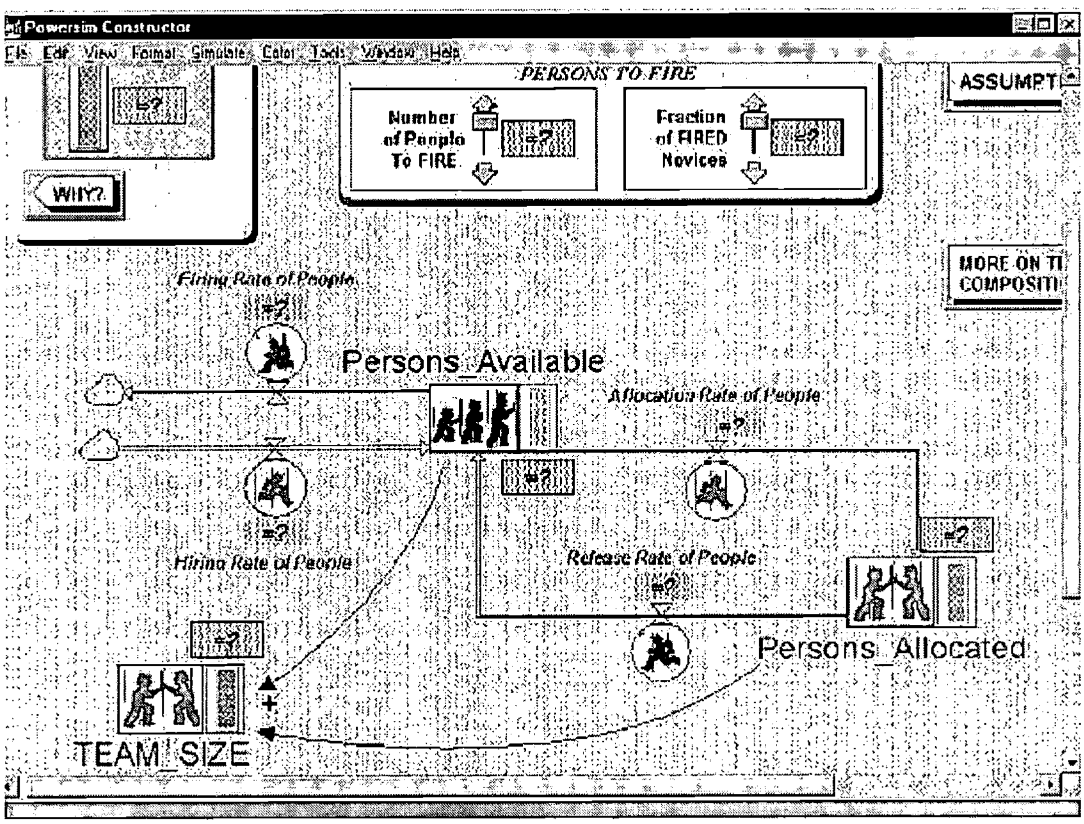

Figure 1: Websim for instructional resource management.

Concluding Remarks

It is premature to argue that this framework will produce significant, long-lasting, and positive learning effects in and about complex systems. Based on existing data collected on our learning environments and from data reported on some of those which adopt similar approaches (Sioutine, Davidsen, & Spector 1998), we believe that there is great promise in designing collaborative telelearning environments from a socially-situated learning perspective with heavy emphasis on collaborative learner participation in the creation and modification of knowledge objects and artifacts. We have been encouraged to learn that the system dynamics community is coming around to the view that it is not generally sufficient to provide only behaviorally oriented feedback about complex systems if one wishes to promote deep understanding of such systems. Learners should be encouraged to engage in model alteration, model construction, and policy and strategy design in a collaborative context if one expects lessons to transfer from the learning environment to real-world settings.

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Design of CORBA based Framework for Cyber University

SeiHoon Lee
Dept. of Computer Engineering, Inha Technical College, KOREA
seihoon@true.inhatc.ac.kr

SeungGeun Lee, JinHyun Tak, HeeChang Koh, ChangJong Wang
Dept. of Computer&Science and Engineering, InhaUniversity, KOREA
{sunguri | tak | hckoh | cjwang}@selab.inha.ac.kr

Abstract : Cyber university is a new field that can overcome the limitation of present education criteria. Student can receive learning in anywhere and anytime using information communication infrastructure. But, many researches in field of cyber university concentrate on development of solutions based application level. These solutions lack a flexibility and adaptability to be adapted in various environment of education.
In our research, we propose a framework that is not application level in solution for cyber university. This framework is designed using CORBA that is standard in distributed object middleware. The CORBA based framework can be integrated with other systems easily.
The framework is mainly composed by four components. Course manager maintains all learning materials using workflow concepts. Student manager maintains profile and conditions of learning for each student. Intelligent agent determines learning step and coarse using student's condition dynamically. Session manager maintains group activity between lecture and students.

1. Introduction

In advance of computing power and networking technologies, Many applications are developed by many corporations and institutes. Especially, Cyber university is a new field that can overcome the limitation of present education criteria[Ellis 1998, Dewy 1998, Lee 1997, Barajas 1998, Mittrach 1998]. In Cyber University, students can access training and performance supports via the Internet when and where they need it[Wade 1998]. And, it significantly reduces the cost and time requirements associated with more traditional types of training. Now, many research and solutions are provided for construction of cyber university[Dewey 1998, Lee1997].
But, the structure of cyber university is regarded as very difficult process because of diversity of educational environments. In spite of diversity, almost of solution and researches are concentrated on application level. Application level based solutions lack a flexibility and adaptability to be adapted in various environment of education[Barajas 1998, Mittrach 1998].
We proposed the framework-based solution for cyber university. Because of framework-based solution, the solution presents flexibility and adaptability to construction of cyber university in diverse environment.

2. Requirment for Framework

Cyber university can maintain a lot of learning contents effectively, and present contents to students by fit methods. Also, It is difficult for students to judge own state of learning and to determine subjects for achieve own goal. Because cyber university is less sufficient interaction between instructor and student than real university, functions that must determine student's coarse and monitor learning state are required. System can diagnose of the state of student and satisfaction of content presented to student, and determine learning step and coarse using student's condition dynamically. Also, because they would like to act on participants in group, group activity can supported by system[Manthe1996, Rezende 1995, Solyoll 1996].
Figure 1 describes the essence of education for cyber university. Cyber university allows students to access the

topics they need, when they need them. Students may choose to play entire chapters, or utilize the search function to answer a specific question. System determines the best course which student can approve to own goal using user requirement. After course is determined, system composes user's profile and prepares learning contents for student and presents it them. Then, students would learn learning contents by determined course. Result of learning is used by diagnose process. Diagnoses result is feedback to profiling.

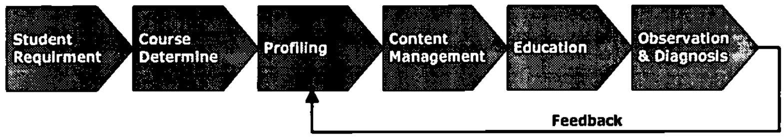

Figure 1. Essence of education for cyber university

- Student Requirements : It is goal which student want to learn through cyber university.
- Course Determine : System determine student's learning course using instructor's knowledge.
- Profiling : It maintains student profile that contains private information with requirement which student want to learn, and topic information which students access.
- Content management : Content management maintains learning contest and provides it to student.
- Education : Students can learn the course and contents decided matching functionality.
- Observation & Diagnosis : The process of learning is monitored continuously and result of student's learning and satisfaction are analyzed and returned feedback to students' profiling.

3. Framework Design

In this paper, we design CORBA based framework for cyber university. The framework is mainly composed by four components and they are designed using CORBA objects. Therefore, this framework is integrated with external application and database. And it is used in heterogenius environment.

3.1 Overview

[Fig. 2] shows overall configuration of cyber university using the CORBA based framework.

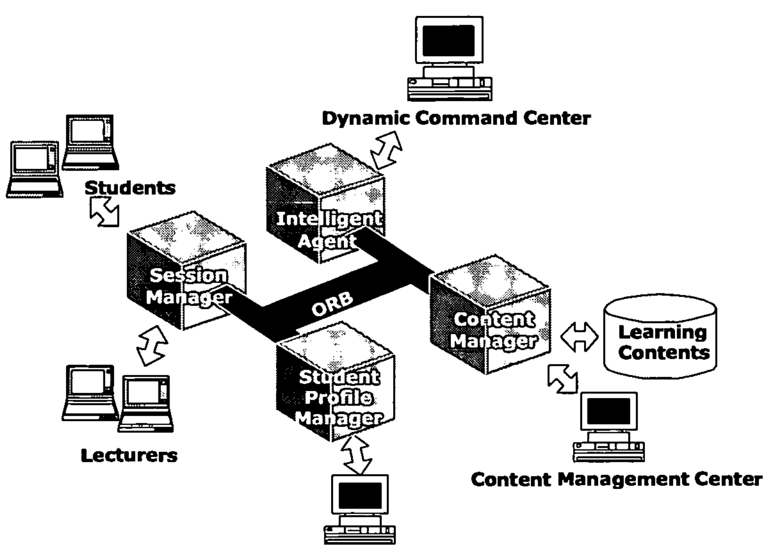

figure 2. CORBA based framework

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3.1 Session Manager

In server side, session manager has group managing module and event handler. [Fig. 3] shows architecture of session manager.

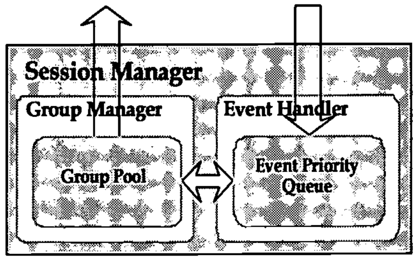

Figure 3: Session manager

Group managing module operates as gateway. It authenticates using information in student profile manager. And it manages group participated by students and lecturer. Event handler processes events that occur in each group. Group managing module creates appropriate group for user requirement, and manages those using group pool. Once event occurs, interaction handler catches that. If it cannot be handled, interaction handler sends it to event handler. Event handler processed that using group managing interfaces. Events handled by event handler require group-related operations such as create, destroy, join, and leave. Table 1 describes operation of Session Manager.

Table 1 Synchronous learning/training operations

Operations	Functions
Basic Operations	Create Group
	Destroy Group
Group Management Operations	Join Group
	Leave Group
	Manage Applications
	Manage Time Event
	Control Token
	Manage Group Context
Data Transmission Operation	Support Unicast/Multicast
Information Management Operation	Manage and Retrieve User/Group Information

3.2 Content Manager

Content manager manages learning contents using workflow concepts. Workflow based data management presents efficient routing of work from person to person or to groups and easy access to pertinent documents. Task is defined students and authors who use contents. Also, Detailed reports of all activities associated with a process. This manager has task manager and flow manager. Author designs the flow and task of learning contents. Task manager and flow manager control the learning content and monitor actions which is performed to contents. Authors and instructors design flow. And course manager maintains components composed in document and relationship among the components. The relationships are made up with update and delete relation. [Fig 4] shows Flow, Task, Task Manager object.

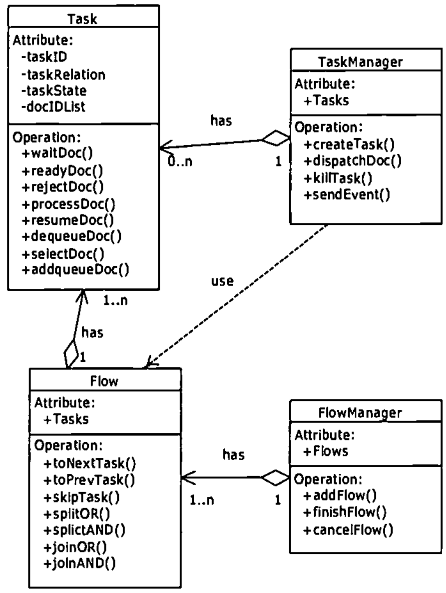

Figure 4. Objects of contet manager

For interface with database management systems, it uses persistence service in Common Object Specification Services (COSS). If we construct cyber university using the framework, this manager is connected to content management center. [Fig. 5] shows Course manager.

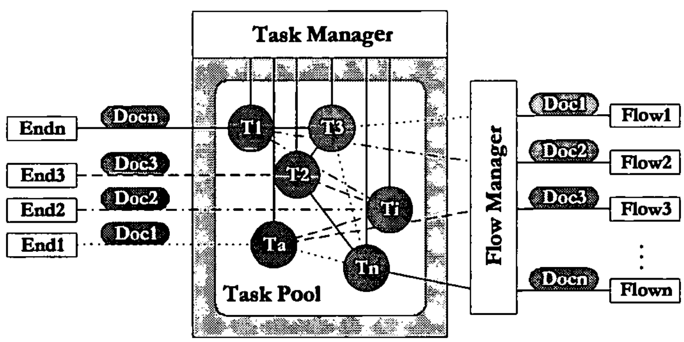

figure 5. Course manager

Content management center helps content professionals-creators, editors and site administrators- manage the full life cycle of content.

3.3 Student Profile Manager

Student profile manager maintains student profile, including student private information, result of learning, learning tendency. Profile manager presents operations described in Table 2.

Table 2 Operations of Student Profile manager

Operations	Functions
Basic Operations	Create Users
	Destroy Users
	Fine users
	Modify user profiles
	Registration user's goal
Maintenance of Learning State	GetLeamigHistory

SetLearningHistory

3.4 Intelligent Agent

Intelligent agent determines student's learning course using requirements. Knowledge base is constructed by instructors. Then, determined result is used for designing process of flow of contents in Content manager. Intelligent agent has extract module and diagnosis module. Extract module extracts parameters for diagnosis of student from result of student's learning and return to diagnosis module. [Fig.6] is IDL(Interface Definition Language) interface for Extraction module.

```
struct Problem_Struct {
        string testNodeID;
        string type;
        string difficulty;
        string correctness;
};
typedef sequence<Problem_Struct> Problem_info;
interface Extraction {
        string Solving_Problem(in User_info user, in Problem_info problem);
        string Learning_Node(in User_info user, in string Next);
}
```

Figure 6. IDL interface for Extraction module

Diagnosis module diagnoses learning state using parameters from extract module. Diagnosed result is used for updating profile information. [Fig.7] is IDL interface for Diagnosis module.

```
struct Condition_Struc{
        User_info user;
        string condition;
};
typedef sequence<Condition_Struct> Condition_info;
interface Diagnosis {
        Condition_info Examine( in string User_input );
}
```

Figure 7. IDL interface for Diagnosis module

4. Conclusion & Future Works

Designed framework has several advantages. It can provide flexible and adaptable solution for construction of cyber university. Learning course is designed automatically using student's requirements and result of learning is analyzed and feedback for the bast fit education can be presented to students. Workflow based content management supports step-by-step education.

Also, because the framework is designed using CORBA objects, system expansion and integration can be done easily. There is an important feature to enhance educational values of this system. Currently, We plan to implement integrated distance learning system that using this framework.

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Using the Internet in the Classroom: Variety in the Use of Walden's Paths

Frank M. Shipman III, Richard Furuta, Haowei Hsieh, Luis Francisco-Revilla, Unmil Karadkar, Abhijit Rele, Gurudatta V. Shenoy, and Donald A. Brenner
Texas A&M University
Center for the Study of Digital Libraries and Department of Computer Science
College Station, TX 77843-3112 USA
{shipman, furuta}@cs.tamu.edu

Abstract: Walden's Paths provides annotated guided paths over World-Wide Web pages. Designed as an approach for organizing classroom use of contextualized Web-based material, Walden's Paths provides a general mechanism suitable for use in implementing a range of different pedagogical strategies. This paper reports on some of the uses that teachers have made of Walden's Paths. One of the surprises for us in this project has been the range of ways in which Walden's Paths can be used in practice.

Introduction

Over the past three years we have been developing Walden's Paths (Shipman et al. 1997; Furuta et al. 1997; Shipman et al. 1998), software supporting the use of existing Web-based materials in elementary and secondary classrooms. This work has been motivated by the belief that as more information is made available via the Web, that there is a greater potential, and indeed need, for educators to make use of this resource.

The Internet is becoming an intrinsic part of society and the most effective method of distributing many types of information. Because of the relatively low publication cost of the Internet, economic pressures will favor increased use of it for information dissemination. Schools will have to find methods of making use of this resource or ignore a growing amount of content with educational potential. The question should not be whether to use the Internet in the classroom but how.

There are a number of problems with using the Web in the classroom. The Web is an unedited publication media and so there is information that is inaccurate and inappropriate for students. Web materials, when on topic, are most often authored for other purposes than education, leaving students confused due to their lack of vocabulary or context. Finally, browsing Web materials can reduce the student to being a "button presser", navigating from page to page as they might flip from channel to channel on television.

Walden's Paths represents one attempt to ameliorate these difficulties by providing teachers a way to focus student exploration, to add explanation and context to materials, and to integrate the Web resources in the existing classroom environment.

The next section of this paper provides an overview of Walden's Paths' functionality and interface. After this we present examples of how teachers have made use of Walden's Paths within the context of their existing curriculum. This leads to a discussion of issues for the use of Walden's Paths and, more generally, the use of the Web in the classroom.

What is Walden's Paths?

Walden's Paths, named after the paths Thoreau unselfconsciously created through the woods while living at Walden Pond, is a tool that allows teachers to construct guided paths using the information on the Internet. Like Thoreau's trails, guided paths provide structure through an otherwise unstructured environment.

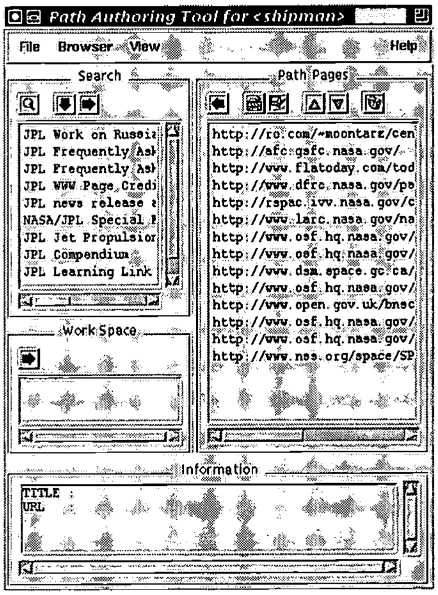

Figure 1: The Path Authoring Tool

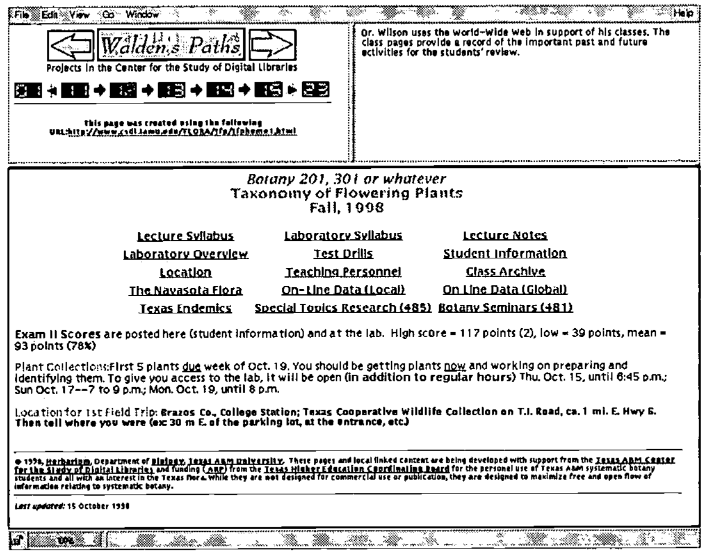

Figure 2: A path page created by the Path Server

The guided path as a concept goes back at least as far as Vannevar Bush's Memex (1945). Paths have been developed in specialized software environments and investigated with limited user communities in the late 1980's (Zellweger 1989; Trigg 1988). Paths in Walden's Paths are an ordering of Web pages with associated annotations. The pages used can be from anywhere on the Internet and their ordering in the path is independent of any existing navigational structure.

Walden's Paths consists of three components, a Path Authoring Tool for creating and editing paths, a Path Database for storing, retrieving, and sharing paths, and a Path Server that provides access to published paths.

The Path Authoring Tool, shown in Figure 1, is a Java-based interface that allows keyword searches for Web materials, the display of those materials in an external browser (e.g. Netscape Navigator), and the selection, ordering, and annotation of pages for the current path. The authoring tool also includes a "Work Space" for storing pages that do not fit into the current path but may be of use in the future.

Authored paths are stored in the Path Database. This database provides each authorized path author with a working area for storing paths. Paths stored here are not visible to the students and may be recovered for editing or continued work. When a path is ready for access by readers (here we are using the term reader instead of student to convey that the person accessing the path is not necessarily a student) it is "published" to the Path Server.

The Path Server is a Common Gateway Interface (CGI) program that creates the list of available paths and their presentation for readers. When a reader requests a path page, the Path Server constructs control-flow and annotation frames to appear at the top of the browser and requests the material from the source site on the Internet to appear in a lower frame (as shown in Figure 2). The reader can use the control-flow controls to step along the path. In addition, the links in the source page remain active. Following any of them takes the reader off the path, as shown in Figure 3. In this mode, further unconstrained browsing is permitted. The reader can return to the path departure point at any time by selecting the "return to path" button in the Walden's Paths navigation area of the display.

Use in the Classroom

The variety of ways in which Walden's Paths has been used to take advantage of Web-based materials in the classroom has been one of the surprises during the project. Our original conception of educational paths was that they would be created by teachers for use in the classroom as a convenient way for collecting widespread materials. We expected that teachers would then use the paths in ways similar to the use of traditional filmstrips—as an enabling way to direct their students' traversal of a sequence of related information items. In use, we discovered that

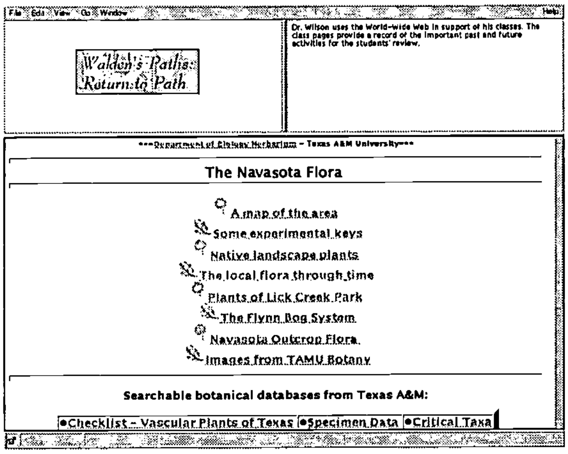

Figure 3: Off the path

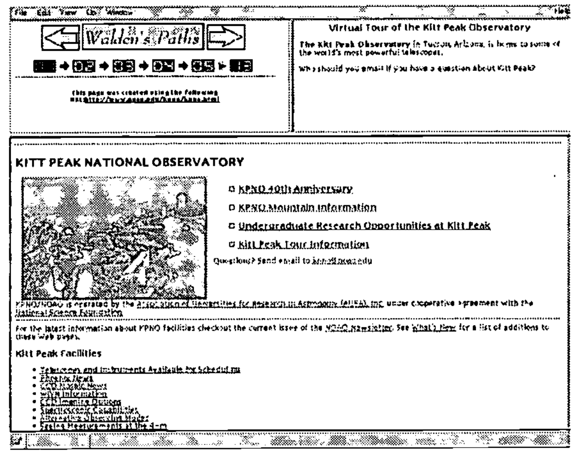

Figure 4: Kitt Peak Observatory path

this, indeed, did occur. However we also discovered that unexpected uses arose as well; uses that reflected a mixture of roles for both the materials and for the students. The following subsections will describe five separate uses of the system by teachers. For privacy reasons we do not identify the specific classrooms involved; some are located in Texas and others on military bases in Germany and Italy.

Embedded Assignments

A middle-school science teacher decided to use the path mechanism to create a virtual tour of the Kitt Peak Observatory. By collecting pages from different Web sites, he created a tour that not only described Kitt Peak, but also compared it to other observatories. A page from this path is shown as Figure 4.

The teacher made much use of the annotation feature of Walden's Paths, helping provide transitions between the information on the different pages and embedding questions for the students to answer on each page. The students, while traversing the path, were asked to answer (on paper) the various questions making use of the information provided on the pages.

The features are most interesting with this use of Walden's Paths are the mixtures of media—electronic and paper—used in achieving the teacher's classroom goals. Here, the teacher has blended Walden's Paths annotation feature with a paper-based assignment to focus and enhance the acquisition of information from the mixture of electronic information resources presented.

Modernizing Existing Practices

In a high school art and art history class, a teacher who had been using slides of paintings and sculptures for reviews and exams decided to use Walden's Paths to improve current teaching practices. Traditionally, during an art history review or exam, the students have to fill out a form as the teachers presents images in a 35mm slide show. Questions on the form might include the artistic period or style of the piece, the artist, defining characteristics of the piece, etc.

One problem with this approach is that each slide is available to the student during a short period of time. The student must quickly write down answers to the questions before the next slide appears. The teacher decided to replace the 35mm slide show with paths of images from on-line museums. In the revised exam each student could spend as much they needed on each image (within the time constraints of the class period).

The interesting feature of this use is the way in which a traditional teaching practice could be adapted and improved using the new medium. The updated solution preserves the familiar characteristics of the original situation while overcoming the technological limitations imposed by the equipment used previously.

Resources for Creative Work

A high-school computer music class teacher used Walden's Paths as a way to identify useful resources to students. Due to the technical nature of the computer music class there were few textbook resources available but much information on the Web.

The students, whose task it was to compose a new piece of music using MIDI, needed both explanatory and reference materials on the equipment and software they were using. The teacher created paths connecting sites with useful information on MIDI to act as a shared bookmark list for the whole class. Thus the teacher created a resource that enabled the use of Web-based materials in support of existing creative/constructive tasks.

The use of Walden's Paths to collect separate resources together to form a convenient package appears to be a common use of the system as we have observed it in other teachers' applications as well. In this use of Walden's Paths, the contextualization of information is not as important as is the coalescing of it in one place.

Class Projects

Another high-school music class used Walden's Paths in support of learning about musicians and music history. The unique aspect of this use is that Walden's Paths became an authoring environment for the students. The students had to form groups, pick topics, and author paths on these topics much like traditional group assignments to write reports on a particular topic.

Topics of paths ranged from specific composers and artists to areas of music (e.g., jazz). The students had to search and browse the Web to locate information on their topic and compose a useful path on the topic. The information selected by students included materials on music history, on the time period and context of the music, biographies of artists, and renditions of specific pieces.

A similar project was carried out in another high-school music class where each student had to suggest one or two pages for a class path on a particular topic. The students had to provide a reason why they thought their suggestion should be included in the path (why the reader would find it useful, or a description of the type of information it provided.) In this case, the teacher acted as a filter on what pages were included in the path.

While such an open-ended project could be given to students in this high-school classroom, there might be difficulties in such an assignment for younger students due to the challenges of locating information on the Web.

Extra-Credit

Another case of students authoring paths came in a high-school art class. In this case, an individual student, who was ahead of her fellow students, was given assignments for authoring paths that could be used by other students. This not only provided the student something creative to do that related to the course curriculum but also provided the teacher with assistance in developing materials for other students.

The positive feelings associated with seeing ones own work available to others helped drive much of the early publication on the Web. The publication of paths can be used as an incentive for students.

Discussion

The experience we gained from applying Walden's Paths in schools suggests some additional observations to us, which perhaps are less-related to the specific characteristics of our technology and more outcomes of Web-based projects in general. In this section, we discuss some of these issues.

Technological and social solutions

Paralleling the observations that we have developed earlier in this paper about incorporation of new technology into existing practices and association with existing artifacts, we were struck by the effectiveness of combined technological-social solutions in resolving technology-introduced issues. A frequent concern expressed to us during the development of the Walden's Paths project have been the issues surrounding identification of appropriate material for use by schoolchildren, particularly those in lower grades. The path allows the selection of suitable materials and the annotation associated with path material permits the teacher to provide contextualization of that material. However, off-path browsing remains unconstrained, as do general browser controls.

Our early assessment of the situation was that the commercial sector was likely to provide technological solutions that would ease this situation through the development of blocking software. To a good degree, this seems to be the case. However, we were impressed by the simplicity and effectiveness of the solution adopted by a middle-school teacher in one of our test sites—rearranging the classroom to place the newly-obtained computers in the center of the room, surrounded by the desks of the students.

Local and global path visibility

Addressing issues relating to intellectual property protection have been among the most interesting, challenging, and persistent topics faced by the Walden's Paths project. As we reported in a previous paper (Shipman et al. 1998), early concerns focused on reader confusion between content and container—between original source material and navigation/annotation material provided by Walden's Paths. We have carried out several redesigns of the reader's interface to make these distinctions stronger; the design shown in this paper's figures is the latest in this process. However, we have come to recognize that an interacting issue is that of path visibility.

Paths have been created for many purposes—to serve as a resource for an individual classroom, to communicate findings from a student to a teacher, to promote a class' efforts to the outside world, and to serve as a guide providing an overview of a Web site or organizational location. Implicit in each of these uses is an expectation of who the appropriate audience will be for the path—an individual, a localized group, or the whole Web. Our current path directory mechanisms do not allow the identification of the intended reader population, providing global access, but not localized access. This leads to confusion both by readers but also by content providers who notice unexpected changes in access patterns as the paths become more widely used.

One of our current project priorities, therefore, is the development of a richer directory implementation that will enable more fine-grained specification of the community of interest for paths. However a more comprehensive solution may require the development of a more flexible model of ownership and location for Web resources.

The Path Server is essentially operating as a proxy server—obtaining requests from clients and redirecting those requests to servers. The TranSend project at U.C. Berkeley (http://transcend.cs.berkeley.edu/), which provides a generally-available proxy service, noted an unexpected side effect of their service, namely the general availability of services site licensed to the Berkeley campus. This was because their proxy service runs inside of Berkeley's domain; special action was required to restrict access to licensed services.

In our current implementation, material is only redirected when on a path (off path material is obtained directly by the client computer and is subject to the restrictions at the client's site). Consequently we have not yet encountered a corresponding situation although the potential exists for a path author to take advantage of our architecture to allow outside access to restricted services. A comprehensive solution here may also involve reexamination of ownership for Web resources.

Conclusions

In this paper, we have described some of the unexpected uses of Walden's Paths that appeared during teacher use. Although we had specific pedagogical goals in mind when we initiated the project (Shipman et al. 1996), our current evaluation is that the tool created is relatively independent of specific pedagogy. Consequently, Walden's Paths can be incorporated into a variety of teaching practices. Furthermore, if specific pedagogical guidelines are to be supported, Walden's Paths provides an appropriate substrate for implementation of authoring filters that encourage following of those guidelines.

The Walden's Paths Web pages are located at http://www.csdl.tamu.edu/walden/

Acknowledgement

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Distance Learning, the Internet, and the ADA

Sheryl Burgstahler, Ph. D.
Adjunct Associate Professor, College of Education
University of Washington
United States of America
sherylb@cac.washington.edu
http://weber.u.washington.edu/~sherylb

Abstract: The potential of the Internet to deliver instruction should not be underestimated. However, Internet use raises a number of issues, including equitable access. The Americans with Disabilities Act (ADA) requires that programs in the United States be made accessible to qualified participants with disabilities and the ADA accessibility requirements apply to Internet resources. Distance learning course developers should, therefore, take steps to assure that their courses are accessible to students with a wide range of disabilities. But, what does this mean for a course offered over the Internet? This paper discusses access issues and provides an example of an accessible course that is currently offered via the Internet.

Much has been written about the revolutionary impact that networking technology is having and will continue to have on all levels of education. Multimedia, simulations, real-time communications, interactions with artificial intelligence systems – the list of capabilities seems endless. Distance learning classes, once conducted using postal mail, FAX, and the telephone, are rapidly being converted to Internet-based delivery systems (Driscoll 1998; Garrison 1989; Palloff & Pratt 1999; Stewart 1995). Although the electronic delivery of courses is unlikely to completely replace traditional classroom instruction, this powerful option for the delivery of information and the facilitation of communication should not be ignored or underestimated by institutions of higher education, corporations, and other organizations.

One issue that should be raised when the Internet is used to deliver instruction is that of equitable access. The Americans with Disabilities Act (ADA) of 1990 requires that organizations in the United States that provide programs and services to the public must provide the same programs and services to people with disabilities that they provide to people without disabilities. According to this law, no otherwise qualified individual with a disability shall, solely by reason of his/her disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination in program offerings. When people think of the ADA they usually think of accommodations such as elevators in buildings and lifts on busses. But, according to the United States Department of Justice, the ADA accessibility requirements apply to the Internet world also. A 1996 opinion letter ("ADA Accessibility," 1997) states that "Covered entities that use the Internet for communications regarding their programs, goods, or services must be prepared to offer those communications through accessible means as well." Specifically, if you offer a distance learning course via the Internet, to comply with the law, your offering must be made available to students who have disabilities.

Distance learning course developers should take steps to make their courses accessible to students with a wide range of disabilities. They can employ "universal design" principles to assure that their materials are not only accessible to the average student in a class, but to all students who might enroll, including those with disabilities. But, what does this mean for a specific course that you may wish to offer over the Internet? This paper discusses access issues and provides an example of an accessible course that I currently offer via the Internet.

The Students

With the rapid development of adaptive technologies that allow people with a wide range of disabilities to access computers, students with the following characteristics may be attracted to a distance learning class offered over the Internet.

- Trevor is blind. He uses a computer with voice output. Basically, Trevor's computer reads with a synthesized voice whatever text appears on the screen. He uses a text-only browser to navigate the World Wide Web. One of the challenges he faces when he accesses Web sites occurs when graphics appear and there is no text alternative for his voice output system to read. He may just hear "graphic" when a detailed picture of the anatomy of a frog is presented on the screen, "link" when no further descriptive text is provided in the link, and "image map" in place of the beautiful image map with linkable options that sighted visitors see.

- Maggie has low vision. She uses special software to enlarge all screen images. Even with her large monitor, she only sees a small portion of a Web page at a time. She is challenged when pages are cluttered and when the page layout is inconsistent from one page to the next.

- Mark is deaf. The Internet has been a great resource for him since, for the most part, the ability to hear is not required. Lately, however, he is running into more and more multi-media sites with sound clips that are not captioned or transcribed. He becomes totally lost.

- Sarah was an innocent victim in a drive-by shooting. Her brain injury has resulted in impaired fine motor skills. She uses one hand to operate a keyboard and track ball. She finds it difficult to select buttons on the screen when they are very small.

- Ryan, a bright college student, has a learning disability which impacts his ability to read and organize information. He has difficulty understanding Web sites when the information is cluttered and unorganized and when the screen layout changes from page to page.

How can you assure that these students will be able to access a distance learning class that you offer on the Internet? I will share what I have learned in teaching an Internet-based course for three years.

The Course

My *Adaptive Computer Technology* distance learning class (Burgstahler, 1997) is designed for teachers, parents, service providers, and computer lab managers. It is offered for three college credits in both rehabilitative medicine and education through the University of Washington in Seattle. The course surveys the field of adaptive technology as it impacts the lives of people with disabilities, including applications to employment, education, and recreation. Topics include interface devices, computer applications, compensatory tools, access to information technology, legal issues, and implementation strategies.

The electronic mode of delivery is an excellent choice for this course. Because of its specialized nature, few people in one locality are interested in taking it at any specific time. Students have participated from throughout the United States as well as from Canada, Italy, Germany, Japan, Australia, and Hong Kong. Being in the same place at the same time is not a prerequisite for participation. Students who have successfully completed the course include those who have visual and hearing impairments, mobility impairments, and specific learning disabilities. Design features of the course have made it accessible to everyone who has enrolled.

The Instructors

The first time this course was offered I taught it with a co-instructor who is blind and lives in New York. Since his computer is equipped with a screen reader and speech synthesizer, he required no special accommodation as we developed the course. We prepared materials and coordinated lessons via electronic mail. We "met" many times to discuss the progress of the course, but never in person.

The Instruction

Students in the *Adaptive Computer Technology* course purchase textbooks and videotapes before the class begins. They are placed on an electronic distribution list managed by standard ListProcessor software. The distribution list is used to send the syllabus and other course materials to the students. Lessons are distributed over a period of 10-12 weeks, but discussions continue for a total of six months. Students are required to read and respond to electronic mail at least once per week during the time that lessons are distributed. Class participation is required. To keep communications lively and prevent some students from just "lurking," I require each student to contribute at least one comment to each lesson discussion. Once distributed, the lessons are archived on the course World Wide Web site where students and instructors can easily access them.

Textbook reading and videotape viewing assignments are distributed via electronic mail with the weekly lessons. After an assignment is given to read material or watch a videotape presentation, the class discusses the content via the electronic distribution list. Small group discussions break off from full-class discussions from time to time as individuals find common interests with others. Participants also communicate individually with each other and with me via electronic mail. Guest speakers join in class discussions periodically. One regular guest speaker is the author of the course textbook. He lives far away from me and is an adaptive technology user himself. He usually joins the discussion list for two weeks.

In this distance learning course, all assignments are turned in to me via electronic mail. Students share summaries with their classmates via the course distribution list. The first assignment for students in class is to distribute an introductory biography to the class. Some of the required "papers" involve writing on a topic related to the course content using Internet resources, visiting a local facility and evaluating computer access for individuals with disabilities, and making recommendations regarding access to a specific facility or program. When ready, each student requests the final exam via electronic mail. Once it is delivered, he/she has several days in which to complete this essay test and return it to me via electronic mail.

The Accessibility of the Course

For the *Adaptive Computer Technology* course there is no meeting "place." This means that finding an accessible classroom to accommodate students with disabilities is not required. In this course, the primary vehicles for learning are a textbook, videotape, electronic mail, an electronic distribution list and the World Wide Web. Care is taken to assure that each delivery mode is accessible to all learners.

Textbook

The required textbook for this class is available in recorded form for students who are blind or who have specific learning disabilities. Recorded and electronic copies of books can be purchased from Recordings for the Blind and Dyslexic. On most campuses, the Disabled Student Services office can help instructors determine how a specific text can be provided in Braille, on disk, or on tape if such a request is made.

Videotape

Students in the course also purchase, as part of the required course materials, three videotape presentations which demonstrate key concepts covered in the course. Videotapes are open-captioned to make them accessible to deaf students. In addition, students who are blind can purchase them in audio-described format. This special format provides audio descriptions of videotape content that is presented visually.

Electronic Mail and an Electronic Distribution List

Electronic mail is highly accessible to those with disabilities. Media conversion and other customized accommodations are minimized since all participants are required to have access to computers when they enter the class. Whatever adaptive technologies they use facilitate access. For example, a blind student's computer output method (usually a screen reader and voice synthesizer) translates the course material available via electronic mail into an accessible format (e.g., speech). A student who cannot use her hands can command her computer to "turn pages." Similarly, a deaf student does not require interpreters or amplification systems since lectures and discussions occur on-line.

World Wide Web

A World Wide Web page serves as the course "library." Links to useful sites provide students with thousands of pages of resources for their papers, projects, and extended learning. The course Web pages are designed in such a way that people using a wide range of adaptive technologies can access them (Burgstahler, Comden, & Fraser 1997; Dixon 1996; Resmer 1997). Universal design principles are employed to maximize accessibility. They include simplicity, consistency and redundancy. A few key access issues are discussed below. More detailed Web accessibility guidelines can be found on the Web itself. The site maintained by the World Wide Web Consortium, at http://www.w3.org/WAI/, is a good place to start.

Simplicity

To make Web pages accessible, it is important to use a simple page layout. Buttons, navigational links and logos should be in logical places on each page. A simple page is particularly helpful to people who have visual impairments and to those with specific learning disabilities. In addition, large buttons allow for easy access for individuals with limited fine motor skills as they use mice, track balls, and other pointing devices. A high level of contrast between the background and the text on the screen and simple background designs ease access for people who are colorblind or who have low vision. Using universally recognized HTML (Hypertext Markup Language) tags allows all Web browsers to accurately display the content.

Consistency

Maintaining the same page layout from page to page within a Web site makes it more accessible. Buttons, navigational links, and logos should be located in the same places on each page. A consistent page layout makes navigating the site easier for everyone, but particularly for people who have visual impairments and for those with specific learning disabilities.

Redundancy

Some Web users cannot see images or hear sounds because of sensory impairments. Providing content in alternative formats can make information accessible to everyone. For example, blind Web users typically read the text at a Web site by using voice output systems. They do not have access to information presented in graphical form. Therefore, it is important to provide alternate text for each graphic so that those who cannot view the image can access the information it presents. Captions on pictures should be written in such a way that they are meaningful to visitors who cannot see the pictures. If manuscripts are displayed in an image format or video clips are used, text transcription should be provided. Image map choices should be provided in a text-based list in order to assure that the links embedded in the image map are available to those accessing only the text of the page. Tables, frames, forms, databases and special features should be used sparingly. They are difficult or impossible to use by blind students and, thus, require that an alternative format be provided.

Web pages for your distance learning class should be tested with a variety of Web browsers and monitors. One of the browsers used should be text-only, such as Lynx. In addition, a site can be tested for accessibility using "Bobby." Bobby, created at the Center for Applied Special Technology, is an HTML validator program that tests for accessibility and identifies non-standard and incorrect HTML coding. Bobby is located at http://www.cast.org/bobby.

"Way Cool" Technology

In my distance learning course I made a conscious choice to use simple software tools – electronic mail, distribution lists, the World Wide Web. But, what about chat rooms, specialized bulletin board and conferencing software, interactive video and other emerging technologies? When it comes to people with a wide range of disabilities, generally speaking, the simpler the software (e.g., text-based), the easier it is for them to access. For example, real-time chat systems are impossible to use by individuals for whom input and output methods are slow, whereas simple electronic mail is totally accessible. Video and audio interactions require that access barriers for visually or hearing impaired students be overcome. Whatever tools you choose to use, refer back to the descriptions of Trevor, Maggie, Mark, Sarah, and Ryan at the beginning of this paper. Make sure that they can fully participate in your course.

Conclusion

The Internet is a powerful, flexible, and efficient tool for the delivery of instruction. It provides new ways for us to teach and learn. Distance learning courses offered over the Internet attract people from all over the world. Some potential students have disabilities. A course using the Internet can reduce the necessity for special accommodations for students with disabilities, but only if it is designed with access in mind. Employing universal design principles will make your electronic resources accessible to people with disabilities and will also improve the access for people using older, slower technology. With a properly designed course, those with limited abilities to speak, hear, see, or move will not be limited in participation. In fact, your most "vocal" student may not even be able to speak in the traditional way.

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Strategic Requirements for a System to Generate and Support WWW-Based Environments for a Faculty

Ger Tielemans
University of Twente
Faculty of Educational Science and Technology
The Netherlands
tielemans@edte.utwente.nl

Betty Collis
University of Twente
Faculty of Educational Science and Technology
The Netherlands
collis@edte.utwente.nl

Abstract: Based on long experience with educational software, both as developers and users, and with the use of telematics applications in educational settings, a team responsible for the implementation of more-flexible education within the Faculty of Educational Science and Technology at the University of Twente derived a set of requirements integrating technical and pedagogical principles for a WWW-based course-support system for the faculty. These requirements have been realized in a system built by the team and now is use across the faculty. The paper gives the system requirements, an overview of the TeleTOP system as realized to meet the requirements, and some indicators of the accuracy of the requirements based on experiences with the broadscale use of the system.

Introduction

Since the introduction of computers into education, there have been efforts to develop educational software that could replace the instructor. Despite extensive efforts to adequately model the critical variables in the learning process, the results have generally not led to software that has taken over from the instructor, with exceptions for what Draper calls "niche markets" (Draper, 1998). Within traditional higher education, the use of educational software as a replacement for the instructor, the textbook, the laboratory session, or the lecture, has not much occurred, especially at a faculty level where the scale would be large enough to make an impact on curriculum and program delivery. A number of analyses have studied the implementation problem and share the conclusion that the instructor is a critical variable in any use of educational software in school and institutional settings (see Collis, Knezek, Lai, Muyashita, Pelgrum, Plomp, & Sakamoto, 1996, for an international overview).

The availability of the WWW has brought a new wave of interest into the previous educational-software domain, particularly in higher education. However, we see in many cases a repeat of early ideas that accompanied computers in education, in particular the idea that a WWW-based course could provide a replacement for the instructor. The new variation of this is reduction of the instructor to someone who answers e-mails when students have a question. We believe the same problems will confront WWW-based courses as confronted educational courseware: problems related to not being able to anticipate all the sorts of human-human interaction and issues that arise in the regular teaching-learning situations which the good instructor handles based on his or her experience and intuition. That is why we endorse the use of WWW-based applications as tools to empower and extend good teachers, not replace them.

The Teletop Project

Since March of 1994 enthusiastic instructors in the Faculty of Educational Science and Technology of the University of Twente have been using WWW-based environments to support their regular courses (for a review of four year's evolution of one such course, see Collis, 1997). In these courses, the instructor was not less present or less involved with his or her students, but was empowered by the WWW-based tools to do more than before. Based on the experiences of these pioneer instructors, the reactions of the students, and the idea of extending and empowering, not replacing, the good teacher, the adminstration of the Faculty decided in May 1997 to commit substantial resources to the systemic support of change throughout the faculty: all courses to be re-designed to be more flexible and to embody the principle of extending the good instructor. WWW-based tools were to be the major technological instruments, while extensive work with instructors in a new approach to rapid prototyping of WWW-based course-support documents was a parallel emphasis (De Boer & Collis, 1998a,b). This initiative is called the TeleTOP Project. Along with the authors (who are responsible for the project) are five full-time instructional designers supported by the MediaLab of the faculty. Throughout the 1997-98, all of the courses of the first-year as well as a number of other courses have been redesigned, and are now in operation with a double-sized student group (the normal intake, and a new intake of about the same size of professional persons in the workplace wishing to complete a flexible version of our programme, primarily at a distance but coming to the campus one day every two weeks for intensive face-to-face contact with their instructors). Now, during the 1998-99 academic year, the majority of the other courses in the required program will be similarly adapted.

Requirements

While the original examples in the faculty of use of WWW environments to support courses were those of enthusiastic pioneer instructors, the TeleTOP Project has to deal with a more difficult target group: all instructors, including the less-interested, less-motivated, and sceptical, are to be supported in their re-design of their courses and their design of WWW sites to support their courses. Given these two basic aspects--empower, not replace the instructor with technology; and engage all instructors, with a wide variation in computer skills as well as a wide variety of levels of interest in the use of technology in their own teaching--we developed the following set of 12 guiding principles:

1. To make the threshold of use as low as possible for the instructors, the WWW-environments must be usable by the instructors without having to have a special training course and as easily as they handle a word processor. The TeleTOP team realized this principle by developing a database-generated system in which a flexible course-support environment is available to the instructor. The instructor chooses the features he or she desires to support the course, and only has to type into various types of fill-in forms to organize the notes and other material that is to be put into the WWW site.
2. Students also must be able to use the system without instruction, and no more than a small manual. Once they are familiar with the interface of one course-support environment, they have a consistent interface in other courses, reducing the need to learn to handle new environments with each new course. The environments are to be accessed through familar browsers; no new packages to learn, and nothing that requires them to come to the computer laboratory to use.
3. Similarly, the instructor must be able to do everything he or she wishes with the course through an ordinary WWW browser; no special authoring software, no special client. An instructor travelling out of the country can work on his or her course wherever there is access to the Internet via a standard browser. A guest instructor in another country can enter notes and materials directly into the course site, again without any special equipment and without needing to have access to the server. Thus the system should not be a server-client model, whereby the instructor in addition to the Internet browser has to install special software at the client side to get access to the learning environment.
4. By the principle "empowerment of the good instructor", the instructor must be able to choose for him or herself the way that a WWW site will be used to support his or her course. There is no standard pedagogical model that all are expected to follow. With this in mind, the TeleTOP Team developed a WWW-based Decision Support Tool (DST) (see De Boer & Collis, 1998a,b) to help the instructor get a systematic overview of examples of different ways WWW-based tools can be used within the organizational aspects of their courses, the aspects relating to lectures and face-to-face sessions, aspects related to communication with and among students, to the presentation of course-related materials, to file distribution and the addition of resources to the course site. After an interview session with TeleTOP Team members and the DST , the instructors have a more-informed idea of what is possible, and more importantly, what they will find appropriate to use in their own courses. Directly after the use of the DST,

a WWW-based framework of each instructor's new course-support site is available, to be tried out by the instructor via an ordinary browser. We believe the instructor must be the decision maker about the course site, but we know from our experience with authoring systems for instructors, that this principle often does not lead to any use of the authoring system or products made from it. This our approach involves continual contacts with the instructors.

5. We do not see the course-support sites as replacing the textbooks in the courses or making lectures unnecessary. Instead the course-support sites help the instructor add extra opportunities for student reflection, for communication, for student contribution of additional learning resources, for peer interaction and peer evaluation, and to add a "preparation for" and "follow-up from" each face-to-face session. Thus we conceptualize our course-support environments as information-communication exchange environments, that are also coupled with other information systems of the faculty such as the bureau responsible for student issues and administration.

6. The course-support environments must be capable of supporting a large variety of different types of instructional approaches, from courses focused on reading and written assignments with classic final examinations, to courses with complicated approaches to group work and project-based education. Tools to support any instructional approach must be available, including shared workspaces, test banks, and discussion boards.

7. The system must work will all other WWW products, for example Java applets and plug-ins.

8. The instructor must be able to put in and take out whatever is necessary in the course site without needing direct technical support (although we have student assistants who help out). Uploading and downloading attachments of a variety of types is particularly important.

9. The sourse sites must help instructors organize the information streams within a course; instead of student messages coming to the instructor's e-mail address, for example, they can be posted directly into the course site, either as private (only for the instructor to see) or public (for all in the course to see). Feedback from students or the instructor must follow the same principle. Also, there should be easy-to-set-up ways for messages to be sent to a group of students, or all the students in the course, or other groupings within the course, all from the same WWW environment.

10. Access to the system must be organized on the basis of inlog data which are used by the system database to tailor what can be seen and not seen to each individual. Also it must be easy to leave the system and go to an external site on the WWW and then return to the system, without leaving the browser. Privileges must therefore be regulated at the resource-document level, as to who has read and/or write rights to any item in the database. The author of an item should be able to decide him- or herself who has rights to a submitted item.

11. The system must be efficient to maintain, thus no labor-intensive hand-made HTML pages, but pages generated dynamically out of a database.

12. The system must handle multimedia resources the same as text resources. Video and audio must be streamed over the bandwidths available to the students.

Realizing the requirements: The TeleTOP sytem

On the basis of our prior experiences, a detailed market research of available course-support systems, participation in an international evaluation of several such systems, we came to the conclusion that none of the commercial products we studied met all of our requirements, even those still in the advertisement stage. We needed to proceed quickly; we realized our own system that meets all the requirements listed above. Fig. 1 on the next page shows the basic architecture of the system.

On the basis of a Web database that is optimized for free-format data (because we did not want to decide in advance what an instructor or student may want to include in a course environment) and that can support a large number of simultaneous users (a Domino server, 4.6), we have created an environment that from the instructor perspective is as simple as a great number of hierarchially ordered Web-based fill-in forms. If anyone with the login privileges of an instructor inlogs, he or she sees not only the site as the students see it, but also a number of extra edit-icons whereby on any page the instructor can make changes in the content and even the fill-in forms themselves, can make changes in text or HTML, can add links to external WWW sites (and also to other materials in the database), and can add files as attachments to any page. Anything entered by the instructor is placed on the server and in the database. This concept is carried out on all pages, for consistency and learnability, even the most-complicated pages.

As an example, an instructor can choose for a matrix, or roster model to indicate the organization of a course. Fig. 2 shows an example of the instructor's view of a roster page and of the student's view.

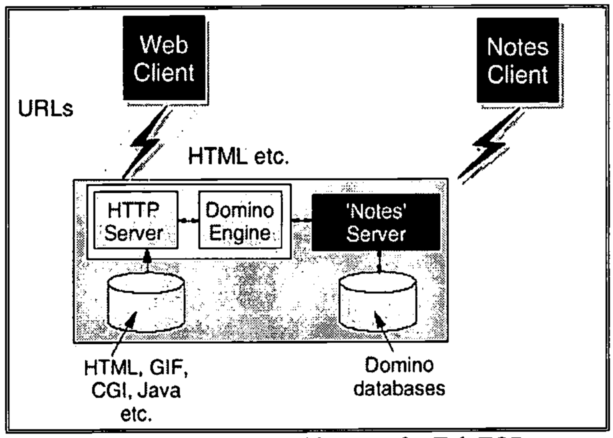

Figure 1. System architecture for TeleTOP

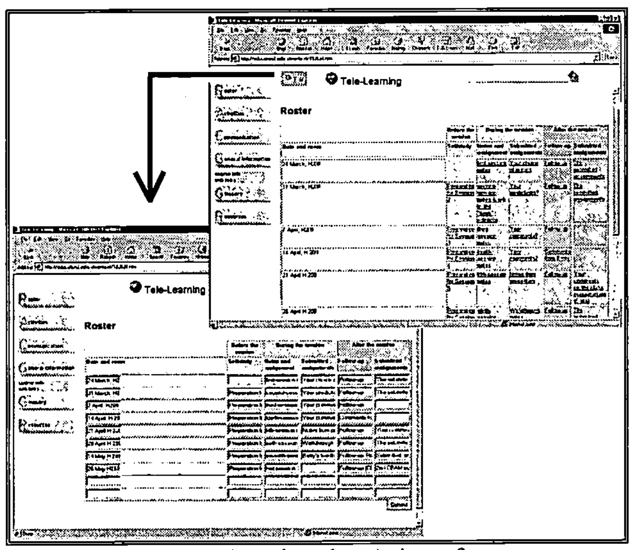

Figure 2. Instructor's and students' view of a roster page.

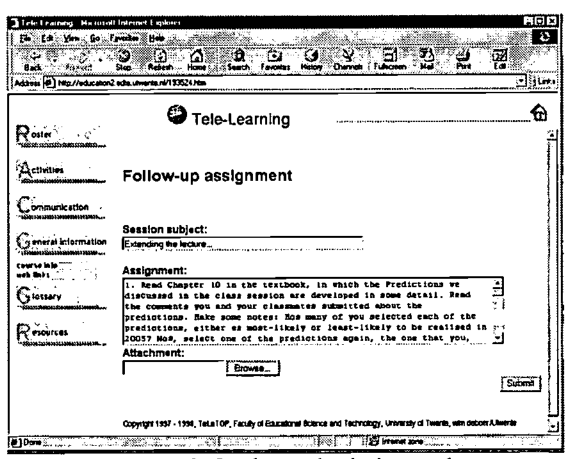

Figure 3. Student submission tools

In the edit view, the instructor can choose to add new rows to the roster, and can choose the labels for each cell in the roster. At the moment that the instructor types in a label on a previously empty cell, for example, a date indicating when a self-study assignment is due, a new page is associated with this link, with a basic fill-in-form and an upload button, so that the student can submit his or her assignment directly through this new page. Fig. 3 shows a page ready for the students to submit an assignment. The students can also decide if they wish their assignments to be readable by everyone in the class or only by the instructor.

Students can move through the course-support site pages, sometimes to submit assignments or ideas through the fill-in-form system, can add files to the site, and can use the e-mail tools for general e-mail communication (standard Internet addresses, sendable within the intranet or over the Internet).

Coupled with the database-server system is a video database, Mediabase, on a Silicon Graphics server. Via this system, video segments in whatever form and length and with whatever bandwide requires the user wishes can be also delivered to the TeleTOP WWW environments.

Experiences with the system

As the system is in use we are also carrying out an extensive evaluation study, led by persons external to our team. Students and instructors, again using fill-in-forms, are being asked to record the amount of time they spend on different aspects of a course and of using the course-support environments as well as many other aspects relating to the quality of the course experience. The first formal results will be published in November 1998 and the final evaluation results in June 1999 (in time for presentation at ED-MEDIA '99). We can say with our results so far that: Even for instructors who were sceptical or showed resistance initially about changing in their teaching, the use of the system is proceeding without real problems. All first-year instructors are using the system and many are coming to the Team to ask for help to try out even more new ideas. The students, and particularly the part-time students attending primarily at a distance, are not having any particular start-up problems (we did all we could to prevent this, by providing them with fully installed computers and modems at a low price, most of which they do not have to pay back if they maintain their grades). The instructors are particularly pleased with being able to make changes and last-minutes entries to their sites whenever they wish, even a few minutes' before a face-to-face session. They also appreciate being able to directly respond to what occurs in the course, by entering the site to make changes or add new materials at any time. Compared to the previous evaluation data from earlier years of using WWW-based environments, the students are finding the environments easier to navigate and use. And, we receive many requests for demonstrations for persons outside the university, who typically are enthusiastic about the system: "A simple to use, transparent system but one with which you can do anything you want in a WWW environment".

Further developments:

Evcn though the current system already consists of a rich WWW-based collection of learning environments, we still have plans to continue extending the system, particularly in terms of logistic management and supporting even more variety in instructional activities. For example, even though the roster approach gives the instructor considerable freedom and a great many possibilities for different types of student interactions, there are two further developments which we feel are important to our Empowering the Good Instructor principle:

1. First, we are beginning to research how we can use video to increase the quality of contacts and communication between instructor and student. We can support videoconferencing, but are particularly interested in capturing via video episodes of good communication during group activities or in a discussion session, and integrating these directly into the course site. This can be to the benefit of persons not at the class session (part of our flexibility principle), but more creatively, can be used to add the students' own ideas and comments, in spoken form as well as written form, to the resources in the course site (see Winnips, Collis, & Moonen, 1998, for an example). We see this as a way to support the Master-Apprentice idea that we believe to be part of good teaching, whereby the instructor and students together can easily access captured video for further reflection.

2. Secondly, we are working to further develop another aspect of the Empower the Good Instructor idea: how to help the instructor find and use small units of learning material such as instructional applets within the course site, not as a replacement for him or herself or the textbook, but as added value. The collection, classification, and use of "learning molecules" from via the roster or anywhere else in the course site, orchestrated by the instructor (or delegated by the instructor to the students) is another area we are working on.

For more information, see http://teletop.edte.utwente.nl

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Development and Administration of a Night Vision Goggle Training Course

DeForest Q. Joralmon
Raytheon Training and Services
United States of America
deke.joralmon@williams.af.mil

Abstract: The U.S. military's emphasis on night operations has made the development of night vision goggle (NVG) training increasingly important. The Warfighter Training Research Division of the Air Force Research Laboratory (AFRL/HEA) has been developing and distributing such training since 1990. This paper documents the development, evolution, administration, and possible future of multimedia-based NVG training courseware.

A videodisc version of the current NVG Training Course contains numerous motion video segments demonstrating various NVG effects. The videodisc provides high quality video and random access to various course elements. However, the videodisc cannot be revised without substantial effort and cost. Established digital video formats such as Video for Windows, QuickTime, and MPEG-1 do not provide the level of resolution necessary to adequately depict intensified imagery visual teaching points. Emerging digital video technologies such as MPEG-2 and DVD may be of sufficient quality to allow for distribution of the course in an all-digital format. Testing and implementation of these newer technologies for converting the course from analog to digital media is discussed.

The NVG Training Course is taught at numerous, dispersed facilities. Telecommunication technologies that are or could be used for course administration such as courseware distribution, user databases, and feedback on course content are addressed.

Introduction

Night vision goggles (NVGs) have been used by the United States Armed Forces since the 1940's. The technology has vastly improved since the first devices, using infrared illuminators and detectors, were mounted to sniper's rifles in World War II. Some current third generation NVGs have such improved resolution that one can see 20/20 under optimum conditions.

The increased use of NVGs by the U.S. Air Force (USAF), U.S. Navy (USN), and U.S. Marine Corps (USMC) aviation communities created an expanded need for NVG training. The Warfighter Training Research Division of the Air Force Research Laboratory (AFRL/HEA) has been developing and distributing such training since 1990. One product, the Night Vision Goggle Training Course, is the initial curriculum for USN, USMC, and USAF aircrew who fly missions with NVGs. The NVG Training Course is not specific to any one aircraft type as it addresses training objectives common to most tanker, transport, helicopter, fighter, and attack aircraft.

There is a standardized configuration for the physical layout of facilities used for NVG training in the United States. This configuration is known as a "NITE Lab" and can be housed in existing buildings, doublewide trailers, or new buildings. A large portion of the NITE Lab consists of the classroom. The classroom is normally configured to handle up to 15 students. Multimedia courseware used in the training and the equipment necessary to present the courseware are located in the classroom. A terrain board is also part of the facility. These boards are typically eight to ten feet square. The terrain board depicts a variety of terrain including an airfield, landing zones, cultural features, water, mountains, farmlands, desert, and forests. A light source is used to provide light levels ranging from overcast starlight to full moon. The light source can also be adjusted to emulate different moon angles. Students, viewing the board through NVGs, stand around the terrain board and observe various phenomena as presented and described by the instructor. Another important element of the NITE Lab is the eye lane. The eye lane is a light-tight room equipped with resolution charts and an illumination device. The eye lane is used to teach aircrew proper NVG adjustment and assessment procedures.

This paper documents the development, evolution, administration, and possible future of multimedia-based courseware used for NVG training in NITE Labs and other facilities.

Multimedia Technologies for NVG Training

Video examples of NVG effects as they happen in the real world are an excellent teaching tool. Such examples are shown to the students to make them aware of various NVG phenomena and the conditions under which they occur. Therefore, intensified motion video segments are an integral part of all NVG training courseware.

Six video programs were initially produced to support NVG training (Joralmon, 1992). These videotapes were used for both primary and refresher NVG training. Each program is approximately ten minutes in length and covers a different topic. The six video programs are entitled NVG Image Characteristics, Luminance Variations, Lighting Issues, Terrain Albedos, Weather Effects, and Navigational Issues.

The six videotape programs were replaced by the first version of the NVG Training Course published in 1994. This courseware is presented via an interactive videodisc. The videodisc is designed to be a multimedia-based instructor aid. All USAF, USN, and USMC NITE Labs are equipped with videodisc players. All of the graphic slides and accompanying motion video segments for the entire course are contained on a single two-sided disc. The videodisc uses Level II programming which allows the instructor to navigate through the various lectures. A Level II interactive videodisc contains all of the navigational programming on the second audio channel. Each time the disc is loaded into a compatible player, the navigation program is loaded into the player's on-board microprocessor thus allowing the courseware to be delivered. The presentation is presented to the class either on a large television monitor or on a screen via a video projector. The videodisc contains six academic lectures and three NVG adjustment and assessment lectures. The academic lectures are Introduction to the Course, The Human Visual System, Introduction to Night Vision Goggles, The Night Environment, Misperceptions and Illusions (specific to fixed wing and rotary wing aircraft), and Night Operations. The adjustment and assessment lectures cover procedures for AN/AVS-6, MXU-810U CATSEYE, and AN/AVS-9 NVGs. A printed instructor's guide is packaged with the interactive videodisc. The instructor's guide contains pertinent administrative information as well as the main course content to be delivered by the instructor.

An alternate way to deliver the initial version NVG Training Course was produced in order to provide the courseware to those units that might not have a compatible videodisc player. The alternate method uses 35mm slides as a storage medium for the graphic slides and a VHS videotape contains the motion video segments. Graphic slides with an accompanying motion segment have a prompt telling the instructor to play the appropriate motion video segment. The graphic slides can also be delivered via a number of different computer presentation programs (e.g. Microsoft PowerPoint). These alternate delivery methods virtually ensure that any unit can present the courseware to students even though there is a loss in image quality when presenting the motion video segments on VHS videotape.

Version 2 of the NVG Training Course was completed in early 1998. Again, the multimedia portion of the courseware is packaged on a Level II interactive videodisc. Revisions to course content were made based on instructor's recommendations. A printed instructor's guide continues to accompany the interactive videodisc. The alternate delivery method uses Microsoft (MS) PowerPoint for presentation of the graphic still frames and VHS videotape for the motion segments. 35mm slides of the still frames are no longer produced. A CD-ROM has been produced which contains the MS PowerPoint files, the instructor's guide (in Adobe Acrobat .pdf format), and other ancillary information.

This next section of the paper discusses multimedia technologies and how they might or might not be suitable for NVG courseware delivery. Current technologies will be discussed first, followed by an examination of emerging technologies. For purposes of this discussion, current technologies are defined as those that are prevalent in society (e.g. computers, CD-ROM drives, and videocassette recorders) and emerging technologies are those that have been recently marketed but have not reached the general public in large numbers (e.g. DVD drives, digital videocassette recorders, and advanced video compression algorithms).

Current Multimedia Technologies

Laser videodisc was chosen as the primary distribution format due to its superior video resolution and random access capabilities. The resolution of a videodisc is much better than that of a VHS format videotape. This is a critical issue in the production of night vision aircrew training multimedia. Video recorded with image intensified cameras has significantly lower resolution than what can actually be seen through an NVG. Therefore, it is important to first record the intensified image on a high-quality videotape format and then minimize the number of generations each scene gathers when it is being edited into a final production. A generation occurs each time an analog videotape is copied and results in some loss of quality.

The disadvantages of laser videodiscs are their high cost to produce and the inability to easily and quickly update the disc once it has been mastered and replicated. This is a significant problem since NVG technology and employment techniques are in a constant state of evolution. The need exists to be able to readily revise NVG Training Course materials. The challenge to date has been how to provide high quality revisions in a timely manner and at a reasonable cost.

The biggest hurdle in transforming the NVG Training Course into an all-digital format is digitizing the motion video segments.

Digital video formats available for use in computer-based training (CBT) and Internet (WWW) applications can be visually intriguing and of high quality. However, the demanding digital storage and processing requirements for full screen, full motion video can result in compromised image resolution. Digital motion video saved in a computer environment can also require enormous amounts of storage space. Hardware and software solutions are available to transform motion video segments into manageable file sizes. However, this transformation process often reduces the resolution of the motion video segment. How much resolution can be lost without negatively impacting the effectiveness of the presentation depends on the specific application. Computer playback of motion video is also demanding. Again, available hardware and software solutions are used to display the video. The quality of software-based playback is dependent on and limited by computer processing power. Hardware playback methods often include enough additional processing power such that full motion, full screen playback is possible.

How good digitized video needs to be is one consideration the courseware developer or educator should ascertain prior to using such presentation technologies. What makes video quality acceptable is dependent on the educational objective or content the video is supporting. In some applications, a low quality "talking head" scene playing back at 10fps may be sufficient. Low or medium quality digital video playing back at low frame rates may also be sufficient to show such items as control panels or displays. Other cases, such as those in which the viewer must clearly see visual details within the image (e.g. night vision aircrew training), require a higher-quality digital video format.

Current digital video formats are not of sufficient quality to support NVG training. Apple QuickTime (.mov files) and MS Video for Windows (.avi files) typically play motion segments back at 15 frames per second. The video is displayed in a small window on a computer screen. Increasing the size of the window can result in the image appearing quite pixelated. Video streams using the MPEG-1 compression standard play at 30 frames per second but again in a small, default-sized window of 352 by 240 pixels within the computer screen. MPEG-1 can be displayed full screen on a regular television monitor, but this requires using two screens for presenting course content. One screen displaying the graphic still frames and another displaying the MPEG-1 motion video segments.

Emerging Multimedia Technologies

Recently emerging digital video formats and computer media show promise that they are suitable for use in presenting NVG training courseware. Two of these technologies being tested by AL/HRA are MPEG-2 video compression and DVD media.

One of the most advanced digital video compression algorithms is the MPEG-2 standard. Full D-1 MPEG-2 video files play back at thirty frames per second on a computer screen in a native size window measuring 720 by 480 pixels. The quality is comparable to (if not better than) analog laser videodiscs. Interactivity and random access capabilities are possible using a variety of CBT authoring, WWW page development and computer programming techniques. MPEG-2 video files can be encoded using various software and, ideally, hardware solutions. The file sizes of MPEG-2 motion segments are large, but the ever increasing storage capabilities of desktop and portable computers as well as interchangeable storage media is sufficient to handle this large amount of data.

The MPEG-2 standard is currently being used in DVD[1] movie titles and telecommunications applications for the transmission of broadcast quality audio and video. DVDs are the same size as compact discs (CD), but can store much more data. A data CD has the capacity of 650 megabytes (MB) while DVDs can hold anywhere from just below 4 gigabytes (GB) to approximately 17GB. These capacities are sufficient to hold the entire NVG Training Course with the motion video segments encoded in the MPEG-2 video standard.

NITE Labs and any other site desiring to use an all-digital version of the NVG Training Course would require additional hardware to support DVD and MPEG-2 technologies. DVD requires a computer drive be placed into the computer supporting multimedia playback in the classroom. The price for a DVD drive is approximately $300. A DVD drive typically replaces a computer's CD drive since the DVD drive can read both DVDs and CDs. Playback of MPEG-2 files is best accomplished with an additional hardware board placed into the multimedia computer. The price for an MPEG-2 hardware decoder is about $250.

Testing of MPEG-2 and DVD technology is currently underway at AL/HRA. Prototype, all-digital versions of the NVG Training Course will be produced, demonstrated[2] and evaluated. Initial test versions will use MS PowerPoint to present the graphic still frames and the motion video segments. Those graphic still frames that have an accompanying motion video segment (not all do) will contain an element that allows the instructor to play the MPEG-2 video file. An example of such a still frame is displayed in Figure 1.

Figure 1. An example of an MS PowerPoint slide that contains an MPEG-2 format video segment.

The presenter clicks on the gray caption bar at the bottom of the photograph to begin playing the video segment. The gray bar is transformed into a video playback control bar and the area that was previously

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[1]The term DVD is becoming the standard form of referring to this specific storage medium. The term was chosen to minimize confusion and ensure commonality between those who thought DVD meant digital video disc and those who thought DVD meant digital versatile disc.

[2]A demonstration of the digital version of the NVG Training Course (using MPEG-2 video files and DVD as the storage medium) will be made during the presentation of this paper.

occupied by the photograph is replaced by the motion video. The photograph and the gray caption bar return when the video segment ends. The presenter then has the option of playing the video segment again or moving to another slide in the presentation. Applications that allow the course to be presented using a WWW browser program will also be tested. There are no current plans to serve the NVG Training Course over the Internet since bandwidth limitations would significantly impede downloading of the large video segment files. Instead, if a WWW browser program were used for presentation, the course would be distributed in a format that would allow playback through the browser program via the host computer.

NVG Training Course Administration

The various NITE Labs are located throughout the United States and abroad. This presents, to course developers, the challenge of administering the course over distance. The NVG Training course has been taught since September of 1994 and several trends have emerged relative to its use. One such trend is that some instructors modify the course to fit their specific training needs. These modifications take the form of either deleting course content or supplementing the course with additional material. The ability to modify a course to suit a specific training need is one reason why having the course in a digital format is desirable. A digital format allows instructors to pick and choose or cut and paste what best suits the training requirements. However, course administrators should be aware of how the course is being altered lest any essential information be deleted or erroneous information be added. Both the deletion of critical information and the dissemination of false information could result in safety of flight issues. Therefore, investigating and reporting on course administration over distance issues could lead to recommendations suited to alleviating any potential problems and lead to better communication amongst those involved in NVG training.

Those involved in administering the NVG Training Course, AL/HRA for the USAF and the NITE Lab Model Manager (located at MAWTS-1 in Yuma, Arizona) for the USN and USMC, handle a variety of course administration-type subjects including course material distribution, NITE Lab hardware acquisition and maintenance, and instructor certification. All of these tasks are typically dealt with using some form of telecommunications (e.g. the telephone, e-mail) since the parties are geographically separated. Currently, there is no formal communication forum between course administrators and course instructors. Communication is primarily one-to-one with no means for one-to-many or group interaction. All involved would seemingly benefit if some system were in place that would allow for the easy exchange of information as it pertains to the NVG Training Course. The following are some efforts underway and recommendations that could assist in the administration aspects of the NVG Training Course.

Recommendations

An effort is being made to establish a comprehensive database that lists all current NVG instructors and their respective point-of contact information. This information includes a description of their teaching facilities (including telecommunications capabilities), the courseware they are using, and the type of NVGs and aircraft used at their location. Two software programs are being used to build the database. MS Access is one and FileMaker Pro 4.0 is the other. It is hoped that upon completion the database can be distributed and/or shared electronically. When the database is complete, it will be important to instill responsibility into the instructors to make sure they keep course administrators apprised of any changes, especially any changes to the course content and any instructor's changes in duty assignments.

At a minimum and as another initial step, an electronic mail broadcast group of instructors and administrators could be established. This would allow asynchronous communication within the group in the one-to-one and the one-to-many formats. An electronic mail group would also allow for attached files (e.g. courseware updates) to be transmitted.

NVG Training Course administration would seemingly benefit and improve if some form of computer-mediated communication (CMC) were implemented. A dedicated system, such as the FirstClass CMC software by SoftArc Incorporated or Lotus Notes, would provide a centralized system of communication for both administrators and instructors. Discussion threads could take place on a number of subjects such as NVG experiences (lessons learned), listing of course errata, technical updates and course materials distribution.

An Internet application could also be used to improve NVG Training Course administration and might possibly be the best solution. Current information could be posted, message boards and discussion groups established (though the author has found such web-based applications less than efficient), and the ability to download files included. A File Transfer Protocol (FTP) site could also be brought on-line. Security issues could be addressed by using Defense Information Security Agency (DISA) networks like Unclassified (but sensitive) Internet Protocol Routing Network (NIPRNET) and Secret Internet Protocol Routing Network (SIPRNET). NIPRNET would be the appropriate network to use for NVG training applications since (at the time of this writing) none of the information is classified. These networks provide certain degrees of controlled access to one's site and thus provide protection to sensitive and proprietary information.

Sophisticated messaging systems are being demonstrated that could be used for NVG Training Course administration (Bryant, 1996). The U.S. Navy X.400 defense messaging system capability allows users "to include all types of media (imagery, video, slide shows, etc.) as attachments to standard navy messages (p. 1). The author does not know the suitability, interservice availability, and full specifications of the X.400 messaging capability at this time but warrant further investigation.

Conclusion

This paper has discussed multimedia technologies that can be used to deliver aircrew training. Such papers serve as a benchmark in the timeline of technology development and implementation. It is interesting to look back at past conference proceedings, see what media technologies were being discussed, and now reflect on the degree of success those technologies achieved. This paper has also discussed course administration issues that are present when a course must be managed over distance. Future testing and implementation of various recommended technologies will hopefully improve upon the quality of continued night vision goggle aircrew training.

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Designing Instructional Multimedia Applications: Key Practices and Design Patterns

Maia Dimitrova and Alistair Sutcliffe
Centre for HCI Design, City University, Northampton Square, London EC1V 0HB, U.K.
M.T.Dimitrova@city.ac.uk, A.G.Sutcliffe@city.ac.uk

Abstract: This paper is divided in two parts. The first part presents a study of the existing design practice in instructional multimedia organisations, and describes the stages of the design process. It reveals the major problems in design, which include complexity of the design process, which necessitates the involvement of a number of specialists from different professional areas, who need to communicate on a common ground, and the tight delivery deadlines against which designers have to compete. In part two, an approach to supporting the design process is proposed. In involves reusing previous proven design expertise through the use of design patterns.

1. Introduction

The effective design of instructional multimedia applications is an intersection of different scientific fields including pedagogy, cognitive psychology, computer science, and media design. The design of such applications is, therefore, a complex process that needs to take into consideration a number of interdependent factors. In a learner-centred approach to designing instructional multimedia, the primary focus should be on the learner and their existing knowledge and experience, as well as the learner's pre-determined learning style, and individual approach to learning (Wild and Quinn 1998). The characteristics of the learning material, and the tasks to be performed during learning also affect learning from multimedia (Najjar 1997). Thus, the media resources that satisfy the information requirements for each task must be carefully chosen while designing the presentation (Sutcliffe & Faraday 1994). To aid designers deal with the complexity of developing such applications, sound methodological support and guidance is required. In order to improve the design process, an understanding of the current approach to design is necessary. In the literature, a number of experiences of designing multimedia courseware have been reported, for instance the WinEcon (Soper 1997). These reports outline main design issues, and how multiple media was used to address the educational needs of that particular applications. Liu et al. (1997) also studied the multimedia production process. However, they emphasised mainly on the overall development process, and do not provide details about the design process. There is a need for more comprehensive studies of instructional multimedia design practices to inform researches of the design techniques used, and the major problems designers encounter.

This paper presents a study of the current design practice in instructional multimedia organisations. Section 2 introduces the designers and the projects examined. The results of the study are revealed in Section 3. A prototypical approach to improving the presentation design process through the reuse of previous design rationale is suggested in Section 4. Some example design patterns are also presented.

2. Study Background

2.1 Multimedia Designers

Eight designers from four educational multimedia organisations within the U.K. participated in the study. The instructional designers came from a variety of professional backgrounds, the majority of who had a mixture of qualifications, including fine arts and social sciences, electronics, electrical, telecommunications, sound and video engineering. Half of them also had a qualification in education or training. The designers' experiences with multimedia ranged from two to sixteen years, with a mean of five years.

The interview questions were divided in five main areas covering designers' experience on a recent multimedia project, the approach adopted to the design, the way of selecting and integrating representation media, any style guidelines applied, and finally the main problems encountered during the design process.

2.2 Design Projects

The projects represented a variety of application areas, which according to their learning objectives can be classified into two categories: training (including Captain Emergency Training, Call Handling, and Hotel Induction), and educational (including Innovation Process Management, Oil Lubrication, and Key Stage 2 Maths). In the training applications there was a well-defined set of learning objectives and skills that the learner had to acquire. The aim was not so much at teaching new knowledge in a subject matter, but at acquiring skills and applying knowledge. In contrast, the educational applications aimed to develop a deeper understanding in a subject matter.

3. Study Results

3.1 Design Process

Although the design methods varied across companies and individual projects, a 'waterfall' approach was adopted, including four main stages: Specification, Conceptual Design, Prototyping and Presentation Design, which are illustrated on (Fig. 1).

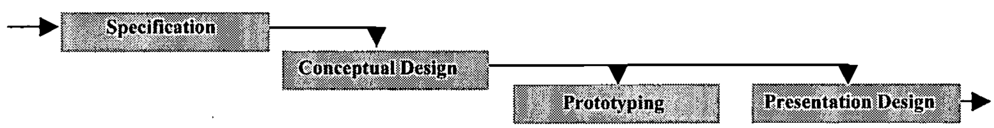

Figure 1: Instructional Multimedia Design Process

3.1.1 Specification

Every project commenced with setting up the aims and objectives of the courseware. This was done in an iterative process with the active participation of a subject matter expert from the client company, or qualified teachers. To be effective, the training material has to be defined in the context of the learner population. However, only in half of the cases the target user population was explicitly studied to identify their educational or professional background (3), computer literacy (2), prior domain knowledge (2), age (2), and job specification (2). There was no evidence that the individual learning styles of the target population were formally established.

3.1.2 Conceptual Design

During the Conceptual Design stage the courseware was specified in detail and the overall presentation style was determined. In five cases, every single training point was defined, including the material to be taught to the learner, and the interactions they had to perform. The content was divided into sections, which were structured in a logical way. In the other three projects, as the content was based on existing material, the content was already defined and structured. The subject matter expert was highly involved in this iterative process.

The learning objectives appear to have a strong influence on the choice of representation style adopted. According to the overall representation approach, the projects can be divided into tutorial, simulation, and game, as shown on (Tab. 1). Apart from the training objectives, other factors reported to influence the choice of representation style were the target learner population, and the budget available.

LEARNING OBJECTIVE	REPRESENTATION STYLE		
	Tutorial	Simulation	Game
Training	■ Call Handling	■ Captain Emergency ■ Hotel Induction (partial)	-
Educational	■ Oil Lubrication ■ Innovation Process Management	-	■ Key Stage 2 Maths

Table 1: Representation Styles According to Learning Objectives

In the tutorial applications, as the primary aim was to provide knowledge and make the learner reflect on it, the material was structured into topics and subtopics. At the end of each section the learner was given the opportunity to reflect on what was learned, by answering test questions, or engaging in activities. Simulation was selected to allow the learner to develop skills and strategies for dealing with certain situations. That was achieved by allowing the learner to interact with a realistic environment, giving them an opportunity to actively explore it (e.g. browse bridge of a ship), and interact with it in order to achieve certain goals (e.g. fight fire on board of a ship). In the Captain Emergency Training application the situation evolved dynamically depending on the user's decisions and actions, who then got to experience the consequences of those actions (e.g. decrease or increase danger of fire), thus providing learning by discovery. Assessment was based on effectively completing the tasks. At the end the learner's performance was assessed against company's standards, and they were provided with feedback as to how they could have reacted better. A game-like approach was chosen to encourage children to learn mathematics by engaging in different problem-solving activities. The system monitored student's problem-solving attempts, and provided them with an immediate feedback on their performance, with an option to look at help screens which provide deeper knowledge of the subject matter.

3.1.3 Prototyping

In all cases some kind of prototype was developed, which was presented to users for their feedback. The content and the level of detail included in the prototype varied from sample screens, images and artwork (4), through screens including partial functionality (1), to a pilot of a full module (3). The way the prototypes were evaluated also varied. Two of the screen prototypes were presented to some users for their comments and suggestions. In the latter four cases, the evaluation included observing users' actions to discover problem areas, as well as getting their feedback. As the evaluation was not done in a systematic way, the user feedback consisted predominantly of high-level comments regarding the colour scheme, or the look of the graphics. Only the pilot prototype resulted in clarifying functionality, verifying the accuracy of procedures to be implemented, as well as adding usability features.

3.1.4 Presentation Design

In the Presentation Design stage the abstractions of the Conceptual Design were mapped onto a real multimedia environment. In five projects scripting technique was used for designing the applications. However, the amount of details included in the scripts varied across projects. In three cases every single screen was defined, including a schematic layout of the screen, detailed description of the graphics and video sequences, as well as precise scripts of speech track and text. The relative position of media resources and their synchronisation were also specified wherever appropriate. Navigation controls were defined, as well as branching from one screen to other screens. In the rest two cases partial scripts were produced, specifying wording on screen, screen layout, questions to be presented, as well as branching to other screens. In the two full simulation cases a different approach to presentation design was adopted. As the material consisted of separate training exercises, each of which had different actions to be performed, first a transition state diagram was created for every possible action. After that the screens for each exercise were designed.

Media Selection

The designers were asked to define the reasons for selecting different media resources used in the applications. The answers showed that the factors considered in selecting the most appropriate media were high-level, and not based on sound pedagogical or cognitive psychology principles. Some factors considered were the learners' characteristics (e.g. reading abilities, computer literacy), and the type of information required. Other factors influencing the choice of media were client's preferences or expectations, limited memory space on delivery platforms, and limited budget. Some media selection heuristics were:

- Use speech as a primary instruction medium, because it is motivating to users.
- If the users are not very computer literate, use speech for instructions.
- Choose animation to represent concrete concepts and explain how they work.
- Select video for representing customer service and customer care skills, as the learner can observe reactions and body language.

Media Combination

For the user to extract the most important information from a presentation, it is vital to guide their reading sequence, as well as to aid them in establishing links between the information presented with different media. From the study, we discovered that very often the decision as to what media to combine and how was left to designer's creativity and aesthetic judgement, and no sound principles of human attention to various media were considered. It appears that there were four main reasons for presenting different media concurrently, which are:

- *Support*: When two different media convey related information, where one or the other medium can present additional information to the other resource. For example, display an image on the left-hand side with supporting text on the right-hand side.
- *Summary*: When one medium summaries and reinforces the chief points of the information presented by another resource. For instance, display bullet point text summarising the main points talked about in speech narration.

- *Explanation*: When one medium explains the information presented by another medium. An example is, where a complex interaction is presented by a set of graphics, speech or text can be used to explain the aim of the activity.
- *Redundancy*: When exactly the same information is presented by two different media resources. For instance, what-to-do instructions can be presented redundantly using speech and text.

Depending on the information requirement, a combination of the above could be used. However, there was no evidence of establishing explicit referential connections between different media presented concurrently.

3.2 Design Guidelines

To establish how much support designers used, they were asked regarding the guidelines and principles they applied in the design process. Five designers reported that their companies had developed presentation design guides. However, four of them suggested that these guides were used primarily to train new staff, and did not get referred to actively during the design process. It was pointed out that the design guides contained only high-level design principles regarding screen, interaction, and navigation design, as well as presentation of text, graphic, audio, and video. However, designers seemed to apply some interface design heuristics, examples of which are:

- Establish a uniform screen layout.
- Avoid using many hypertext links in one page as the user can easily get lost, instead use more rigid menu structure.

3.3 Design Problems

The major problems encountered by the designers fall in two categories: high-level constraints and design problems.

High-Level Constraints:

- *Client availability*: Client participation played an important role in ensuring user's satisfaction with the system. However, most of the designers reported that arranging meetings with Subject Matter Experts and obtaining clarification of content was quite often difficult. Getting hold of sufficient number of users for prototype evaluation, and receiving their feedback on time was another problem.
- *Available budget and delivery deadline pressure*: How sophisticated and interactive media can be created often depended on the budget available. In two cases tight delivery deadlines also resulted in reducing the time spent on usability testing.

Design Problems:

- *Creating workable designs*: In order to produce workable designs, designers had to establish a trade-off between the learning objectives, how feasible the ideas were within the time available, and whether and how easily they could be implemented using the available technology. To achieve that input from domain specialists, designers, graphic artists, and programmers was required. However, some of these specialists were unable to appreciate the multidimensionality of the design space, and therefore lacked common perspective in finding the best design solution.
- *Designing for users with different levels of abilities*: When the target population included users with different levels of computer literacy, finding the right balance between providing such navigation support, which would be sufficient for novices, and would not irritate experienced users, was a challenge. Structuring the training material to accommodate both, more and less technicality knowledgeable learners, was also not easy, as the first group required easy and random access to technical information of interest to them, and the latter group required more rigid structure and less complex terminology.

4. Presentation Design Patterns

The sections above identified three major problems with the current approach to designing instructional multimedia. These problems are: complexity, which necessitates the involvement of a number of specialists from different professional areas, who need to communicate on a common ground, and the tight delivery deadlines against which designers have to compete. One way of dealing with the complexity of design, and reducing the time and effort involved in the design process, without compromising on the quality of the software, is to reuse previous design knowledge when constructing new applications. One way of systematically reusing previous design expertise involves closely examining successful applications, and identifying recurring solutions to common design problems. These can be encapsulated in design patterns. Design patterns have been successfully used in architecture (Alexander et al. 1977), as well as in software engineering, predominantly in the object-oriented software design community (Gamma et al. 1995). A design pattern describes the core of a solution to a particular problem in an abstract way, which when used in a given situation can generate effective design.

In instructional multimedia, presentation design patterns can explore the interactions between the information and task requirements, and their external representation using different media, while explaining the pedagogic and cognitive implications of such compositions on the learner. Their focus on how the media representation can support learner's cognitive processes can ensure effective learning. As patterns can work at different levels of design - dialogue, content, screen layout, navigation - they can attempt to tie these levels together.

From the study, it emerged that five designers reused design rationale from previous projects. For instance, in one case, templates were used for presenting graphics and bullet point text together. In other two cases a uniform screen layout was set across a range of products. The designers found these templates time saving, and a good way of ensuring interface consistency within a product or across a range of products. However, reuse was not done in a comprehensive way. A coherent library of design patterns could potentially speed up the design process, provide professionals with a common lingua franca for communication, ensure interface usability, and pass design expertise to novice designers, so they can produce effective designs faster. Two prototypical design patterns are presented in the next sub-sections. Included are one content (4.1) and one screen layout (4.2) pattern. The patterns are described using a uniform format, comprising of the name of the pattern, the context or the situation which gives rise to the problem, the problem that needs to be solved, the proposed solution, and examples of existing systems, where the patter is implemented.

4.1 How-It-Works Mechanism Pattern

Context: Consider this pattern in representing the working mechanism of a physical object, where the behaviour of the aggregate object is determined by the collaborative behaviour of its components.
Problem: You need to explain how a complex devise works, which is composed of certain parts. There are two main forces that need to be resolved in such representations. Firstly, the user should be able to identify all individual components, and the roles they play in the mechanism, as well as the relationships between the components. And secondly, the user should be able to aggregate behaviour of the components into a semantic behaviour of the mechanism.
Solution: Structure the presentation into four parts. Firstly, present an exploded view diagram of the machine and a textual description of its overall function. Then, present a schematic diagram of the machine and its components, together with textual descriptions of the characteristics of each component. These two parts will facilitate the learner in decomposing the machine into its basic elements. To aid the learner in identifying the spatial relationships between devise components, present different views of the machine. Text and speech explaining component connections should accompany each depiction. Finally, present a realistic animation showing all component behaviours in actual order of occurrence. The animation should be synchronised with speech commentary describing the dynamics of the machine's operation. This will aid the learner in building a dynamic mental model of how the devise operates.
Examples: Microsoft Encarta – The Human Heart, DK Multimedia "The Way Things Work".

4.2 Interactivity Screen Pattern

Context: Consider this pattern in composing a screen allowing the user to perform a learning activity.
Problem: You need to allow the user to perform a learning activity, and to provide them with adequate task instructions at the same time. As the activity is central, and the learner will need to concentrate on it. Task instructions and learning support will have to be presented as well. However, although they are necessary for the successful completion of the activity, they should not obstruct the learner in performing the task.

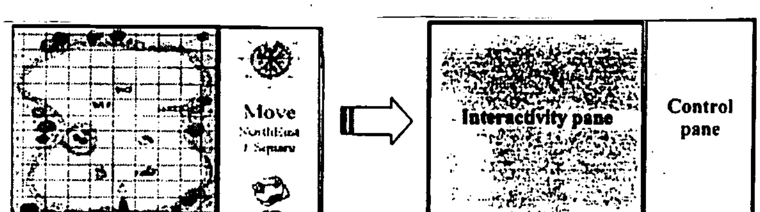

Figure 2: A Sample Interactivity Screen With Left-To-Right Visual Composition (Aircom Education ©).

Solution: Divide the display into two areas: interaction and control (see Fig. 2). As the interaction is central, place it at the left-hand or top side of the screen. Designate the smaller right-hand or bottom part of the display for task instructions and required learning aids. This will focus the user on the interaction. Use text for task instructions,

with redundant speech narration, which can enable the learner to familiarise with the interaction while listening to the instructions.
Examples: Aircom Education "Maths: The Journey to Swallow Farm".

5. Discussion

The study, although limited in size, provides insightful information about the current practices of designing instructional multimedia software. The findings show that the client is involved extensively in specifying the courseware, and reviewing the progress made at the end of every stage, which is important to ensure that client's requirements are met. However, this is not a sufficient guarantee for the usability of the user interface. The study revealed that although some learner characteristics were considered while making design decisions, that was not done in a systematic way. There is a need for a way of ensuring that learner's needs, learning styles, and individual approach to learning are addressed in the design, also suggested in (Soloway 1998; Wild & Quinn 1998). From the study, it became apparent that the selection of appropriate media resources is primarily based on high-level factors, such as selecting speech for motivating the learner. However, studies show that the information requirements for each task, and the cognitively relevant characteristics of the media are vital for allocating the media resources to be used (Sutcliffe & Faraday 1994), which has to be done on a moment by moment basis (Faraday & Sutcliffe 1997). In order to deliver the learning material effectively, designers should order shifts of user's attention according to the content being shown, and ensure that the elements of the presentation are integrated into unified propositions (Faraday & Sutcliffe 1996). However, the four reasons that designers stated for presenting different media concurrently although valid, are not comprehensive enough to ensure that the presentation will not overloaded user's attention, and cause difficulties with comprehending the information presented. Although the guidelines and heuristics presented can be of useful, they are of too high level, and need to be augmented with sound cognitive science and pedagogic principles. This evidence indicates that there is a need to further support the process of multimedia user interface design.

A library of design patterns can prove to be a better way of delivering design knowledge, as the patterns could provide the essence of proven solutions to common interface design problems, augmented with sound theoretical principles. Potentially, this could speed up the design process, provide professionals from diverse backgrounds with a common language for communication, ensure interface usability, and pass design expertise to novice designers. The proposed design patterns lay the foundations of a pattern library for multimedia presentation design. In our future work we will continue extracting design patterns, which will be integrated into a coherent pattern library. A systematic method of applying design patterns will also be developed. Finally, the validity of the patterns will be tested to ensure their benefit to the design process and students' performance.

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Authoring Support for Adaptive Hypermedia Applications

Hongjing Wu, Geert-Jan Houben, Paul De Bra
Department of Mathematics and Computing Science
Eindhoven University of Technology
PO Box 513, 5600 MB Eindhoven
The Netherlands
Email: {hongjing,houben,debra}@win.tue.nl

Abstract: A hypermedia application offers its users a lot of freedom to navigate through a large hyperspace. The rich link structure of the hypermedia application can not only cause users to get lost in the hyperspace, but can also lead to comprehension problems because users read information in an order not foreseen by the author. Adaptive hypermedia systems (or AHS for short) aim at overcoming these problems by providing adaptive navigation support and by providing adaptive content.

We have developed a reference model for adaptive hypermedia applications: AHAM (for *A*daptive *H*ypermedia *A*pplication *M*odel), which is an extension of the Dexter hypermedia reference model (Halasz et al., 1990, 1994). The goal of AHAM is to describe adaptive hypermedia applications, especially from the point of view of authors designing such applications. AHAM divides an AHS into a *Domain Model* (DM), *User Model* (UM) and *Teaching Model* (TM). This paper describes support tools that help authors to create these three parts of an adaptive hypermedia application, and to assure that these parts together form a usable and consistent complete application.

1. Introduction

The rich link structure that is typical of hypermedia applications offers users a lot of freedom to navigate through a large hyperspace. However, it also causes users to lose their way in that hyperspace, and it leads to comprehension problems because users may read pages in an order which the author did not foresee and which may not even make sense. Adaptive hypermedia applications aim at overcoming these problems by providing adaptive navigation support and adaptive content presentation.

An *adaptive hypermedia system* (AHS) (Brusilovsky, 1996) is a special kind of hypermedia system that can adapt the contents and links of an application depending on *observed* user features. For building an AHS, the author has to provide two (related) parts: first of all the author has to write the actual hypertext; second, the author has to specify some dynamic adaptation control information. In practice it turns out to be necessary to provide authoring tools that facilitate the specification of both aspects. In existing AHS (Brusilovsky et al., 1996a, 1996b, De Bra et al., 1997, 1998, Calvi et al., 1997) authoring is often inconvenient, due to the mixture of (textual) content and diverse hints for adaptation. In Interbook (Brusilovsky et al., 1996b) the author must write structured, annotated MS-Word files. In AHA (De Bra et al., 1998) the author must write annotated HTML files. This mixture of content, links and adaptation makes it difficult for authors to maintain a clear picture of how *concepts* relate to each other. This implies that it is hard to define adaptation on an abstract conceptual level.

In (Wu et al., 1998, De Bra et al., 1999) we have presented a reference model for adaptive hypermedia applications, called AHAM (for Adaptive Hypermedia Application Model). In order to separate different authoring aspects, AHAM splits up an adaptive hypermedia application into a *domain model* (DM), *user model* (UM) and *teaching model* (TM). These three parts together form what the Dexter hypermedia reference model (Halasz et al., 1990, 1994) calls the *Storage layer*. Apart from this layer Dexter and AHAM also mention (but do not formally define) a Runtime layer which deals with sessions and the actual presentation and interaction on the screen, and a Within-Component layer which deals with implementation dependent representations of content and links.

In this paper we address operations of DM, UM and TM that are needed for creating (authoring) adaptive hypermedia applications. We describe these operations at the conceptual level, not the implementation level. The definition of these operations shows how the tasks of 1) creating content, 2) combining smaller pieces into composite (abstract) concepts, 3) defining relationships between these concepts, 4) verifying the consistency of these relationships, and 5) defining rules for the adaptation of content and links to each individual user, are separated. The separation of these tasks will make authoring of adaptive hypermedia applications easier than it is today. The separated tasks together form a description of the functionality of an authoring tool based on the AHAM model.

This paper is organized as follows: In Section 2 we describe the AHAM reference model, with its three parts (domain model, user model, teaching model). In Section 3 we show how authoring is facilitated by adding support functions to these three parts. Section 4 concludes and indicates future work.

2. AHAM, a Dexter-based Reference Model

In hypermedia applications the emphasis is always on the information nodes and on the link structure connecting these nodes. The Dexter model captures this in what it calls the Storage layer. It represents a *domain model* DM, i.e. the author's view on the application domain expressed in terms of concepts. In *adaptive* hypermedia applications the central role of DM is shared with a *user model* UM. UM represents the relationship between the user and the domain model by keeping track of how much the user knows about each of the concepts in the application domain.

In order to perform adaptation based on DM and UM an author (or AHS designer) needs to specify how the user's knowledge influences the presentation of the information from DM. In AHAM this is done by means of a *teaching model* TM consisting of so-called *pedagogical rules*. An adaptive engine uses those rules to manipulate link anchors from the Dexter model's *anchoring* and to generate what the Dexter model calls the *presentation specifications*. Like the Dexter model, AHAM focuses on the Storage layer, the anchoring and the presentation specifications. Figure 1 shows the structure of adaptive hypermedia applications in AHAM.

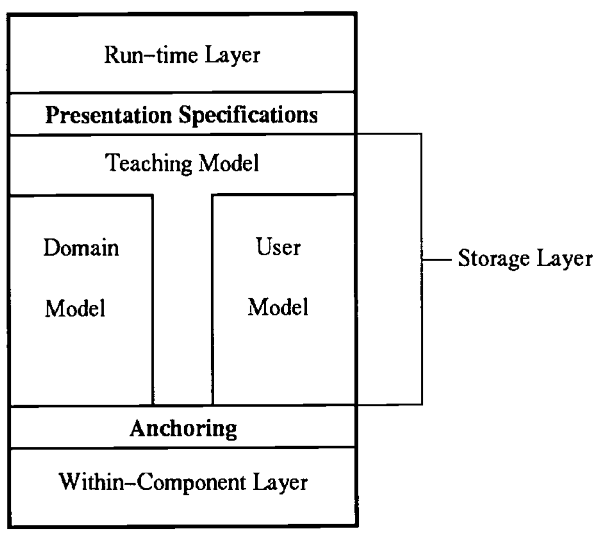

Figure 1: global structure of adaptive hypermedia applications.

In this section we present the elements of AHAM that we will use in Section 3 to illustrate the authoring functionality.

A component is an abstract notion in an AHS. It is a pair (uid, cinfo) where uid is a globally unique (object) identifier for the concept, and cinfo represents the *component's information* consisting of:

- A set of attribute-value pairs;
- A sequence of anchors (for attaching links);
- A presentation specification.

A *concept* is a component representing an abstract information item from the application domain. It can be either an *atomic concept* or a *composite concept*. An *atomic concept* corresponds to a fragment of information. Its attribute and anchor values belong to the Within-component layer and are thus implementation dependent and not described in the model. A *composite component* has two additional attributes:

- A sequence of children (concepts);
- A constructor function (to denote how the children belong together).

The children of a composite concept are either all *atomic concepts* (then we call it a *page* or in typical hypertext terms a *node*) or all *composite concepts*. The composite concept component hierarchy must be a DAG (directed acyclic graph). Also, every atomic concept must be included in some composite concept. Figure 2 illustrates a part of a concept hierarchy.

An *anchor* is a pair (aid, avalue), indicating the endpoint of a hypertext link. The avalue for an anchor in a composite concept is the identifier of a concept that belongs to that composite.

A *specifier* is a tuple (uid, aid, dir, pres), where uid is the identifier of a concept, aid is the identifier of an anchor, dir is a direction (FROM, TO, BIDIRECT, or NONE), and pres is a presentation specification.

A *concept relationship* is a component, with two additional attributes:

- A sequence of specifiers;
- A concept relationship type.

The most common type of concept relationship is the type *link*. This corresponds to the link components in the Dexter model, or links in most hypermedia systems. However, in AHAM we consider other types of relationships as well, that plays a role in the adaptation. A common type of concept relationship is *prerequisite*. When a concept C1 is a prerequisite for C2 it means that the user should read C1 before C2. It does not mean that there must be a link from C1 to C2. It only means that the system somehow takes into account that reading about C2 is not desired before some (enough) knowledge about C1 has been acquired. Figure 3 shows a small set of (only binary) relationships, both prerequisites and links. We treat links and other types of relationships in the same way in order to keep authoring support tools as generic and uniform as possible.

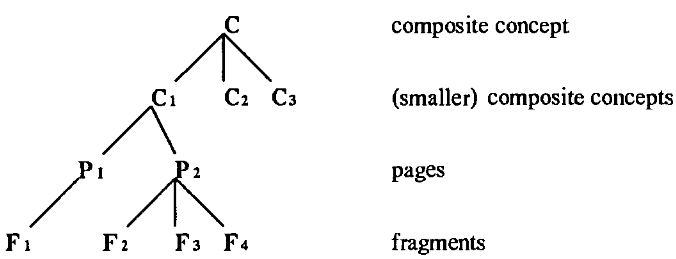

Figure 2: Example concept hierarchy.

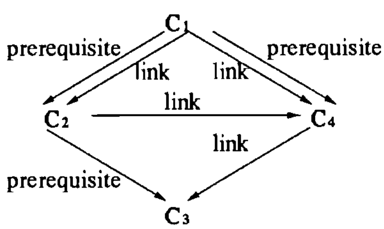

Figure 3: Example concept relationship structure.

The atomic concepts, composite concepts and concept relationships together form the *domain model* DM of an adaptive hypermedia application.

An AHS associates number of (system or author defined) user-model attributes with each concept component of DM. For each user the AHS maintains a *table* in which for each concept the attribute values for that concept are stored. The structure of this table is the *user model scheme*. The table for a specific user is a *user model instance*. If there is no confusion between scheme and instance we just use the term *user model*. One of the attributes of the user model is the unique (concept) identifier. Other attributes commonly found in AHS are the *knowledge value* and some "log" entry whether the user has *read* about the concept. The table below illustrates the (conceptual) structure of a user model, for a course on hypermedia. (In the example table the concepts Xanadu and KMS were at least partially learnt. The concept WWW, consisting of two sub-parts, is partially learnt because WWW-html has been read but WWW-http has not. One can see that WWW must be a composite concept that is not a page because it is already partially learnt while it has not been read at all.)

concept name (uid)	*knowledge value*	*read*	...
Xanadu	well learned	true	...
KMS	learned	true	...
WWW-html	well learned	true	...
WWW-http	not known	false	...
WWW	learned	false	...
...	...	...	...

A *generic pedagogical rule* is a tuple (R, PH, PR), where R is a "triggered" rule, PH is the "phase" for the execution of the rule and PR is a Boolean "propagate" field which indicates whether this rule may trigger other rules. The "phase" of a rule can have the value *pre* or *post*. The phase *pre* is executed before and during the generation of the page, while *post* is executed afterwards. These rules describe how an AHS works, but the AHS is not required to be rule based. In many existing AHS the behavior of the system is completely predefined. But in some newer systems, including AHA (De Bra et al., 1998), authors can add some kind of rules to the system.

A *specific pedagogical rule* is a tuple (R, SC, PH, PR) where (in addition to a generic rule) SC is a set of concepts used in the rule. The rule manipulates user-model attributes and "predicates" over specific concepts of SC.

An AHS may have predefined or implicit generic pedagogical rules. If these rules suffice there is no need for a language in which authors can write new rules. Author defined rules take precedence over predefined rules. Specific rules take precedence over generic rules, and are thus used to define exceptions to generic rules. The existence of the two execution phases makes it possible to do adaptation based on the "previous" state of the user model, and to update the user model to a "new" state afterwards.

A typical standard pedagogical rule for the *pre* phase is the rule that says that a link anchor will be *hidden* (or annotated as undesirable) if some prerequisite knowledge for the destination of the link is still not known. A typical standard rule for the *post* phase is the rule that says that a page-concept becomes *well learned* when the page is accessed and all prerequisite knowledge was present, and it becomes only *learned* when the page is accessed but some prerequisite knowledge was still not acquired.

The *teaching model* of an AHS is the set of (generic and specific) pedagogical rules. An *adaptive engine* (AE) is a software environment that performs the following functions (based on the rules):

- It offers generic page constructors.
- It optionally offers a (very simple programming) language for describing new page constructors.
- It performs adaptation by executing the page constructors.
- It updates the user model (instance) each time the user visits a page.

The adaptive engine thus provides the implementation dependent aspects while DM, UM and TM describe the information and adaptation at the conceptual level.

An *adaptive hypermedia application* is a 4-tuple (DM, UM, TM, AE), where DM is a domain model. UM is a user model, TM is a teaching model, and AE is an adaptive engine.

3. Authoring Support for AHAM

In this section we extend the (data) definitions of AHAM to include the operations that are needed for authoring. Because of lack of space we only give these definitions informally. We distinguish three main classes DM-Tool, UM-Tool, TM-Tool. These indicate which authoring functionality is needed for creating (and modifying) a domain model, a user model and a teaching model. When authoring (adaptive or non-adaptive) hypermedia applications it is difficult to verify global properties of the resulting hyperdocument. By separating domain model, user model and teaching model, the verification of properties becomes feasible and sometimes even easy.

DM-Tool must obviously offer methods to create and delete concepts and concept relationships. These methods may generate interesting side-effects that reduce the (manual) work for the author. E.g., when creating a new atomic concept, DM-Tool can show a dialog box to assign this atomic concept to a composite (which must be a page). When a page is deleted, DM-Tool can show a dialog box to let the author decide what to do with the fragments (atomic concepts) of this page. When a concept is added to a composite, DM-Tool can verify whether the composite only contains atomic concepts, or only composite concepts. We won't go into more detail here, but only describe support methods that work on a global level, and that can be used to verify the integrity of the domain model:

- "verify-hierarchy-is-DAG" checks that no (composite) concept directly or indirectly contains itself (as a child or a lower descendant). This check can be performed automatically each time a new concepts is added.
- "get-orphan-concepts" is used to find the atomic concepts that no longer belong to a page. It is not desirable to force the deletion of fragments when a page is deleted. The author may wish to keep some fragments and add them to other (new) pages later.

Each concept relationship type may have its own constraints. The combination of concept relationship types may introduce additional constraints. Whether DM-Tool can verify these constraints depends on their definition. Some methods for verifying common constraints are:

- "verify-connected-links" checks whether every composite concept (including pages) can be reached by following links from a given starting page.
- "verify-acyclic-prerequisites" checks whether no concept is a prerequisite for itself, either directly or indirectly.
- "verify-conditional-links" checks whether for every composite concept (including pages) there exists a path leading to that concept, from a given starting page, starting with the "default" user-model instance, and without visiting concepts for which prerequisite knowledge is missing.

The third method is a nice example of how the verification of constraints becomes difficult when different types of concept relationships are combined. Also, the verification is based on implicit assumptions about how the user model evolves. Indeed, this verification only works if we make assumptions about how the user model evolves based on the user visiting certain concepts. Figure 3 for instance shows a *sound* structure, only under the assumption that visiting a concept C_i implies that enough knowledge is gained about C_i to warrant that prerequisites that depend on C_i are fulfilled.

In an object-oriented view the UM-Tool can be considered as an object that contains DM-Tool as a part. When UM-Tool contains DM-Tool it becomes possible to model the interaction between the user model and the domain model as being part of the functionality of UM-Tool.

The authoring support of an AHS must include a method for propagating updates to the domain model DM to the user model. In our view this means that UM-Tool needs a method for importing all concepts from DM into UM. However, an author may wish to keep the user model simpler by only keeping some concepts in the user model. Therefore, we have an auxiliary method "verify-all-concepts-in-DM" to check whether all the concepts from UM are in DM, but no method to verify the opposite (because the opposite may not be desirable).

UM-Tool has different kinds of methods:

- "add/delete-concept" is normally available to the author, to manipulate the user model and eliminate low level concepts that exist in DM but are not of interest. (The author may wish to define the adaptation based on knowledge of high level concepts only.)
- "add/delete-attribute" is a method to add a user-model attribute to every concept. It means that the AHS is able to record values for this attribute about each concept. While the AHAM model describes the user model as a table structure in which all attributes are available for all concepts, a particular AHS may have a more restrictive implementation. In the AHA system (De Bra et al., 1998) for instance, there are some "concepts" that represent color preferences for links. These concepts only have a "color" attribute, while the other (real) concepts only

Whether authors can extend the user model with new attributes depends on the AHS. The limiting factor is the ability or inability to actually use new attributes. The *rules* in TM are the (only) means to use new attributes.

TM-Tool provides methods for creating *pedagogical rules*. In the object-oriented view TM-Tool contains DM-Tool and UM-Tool as parts. This makes it possible to describe the interaction between DM-Tool and UM-Tool as being part of the functionality of TM-Tool.

- "add-spec-pre/post-rule" are methods for creating *specific* rules. The author can add rules that work with *specific* concepts. The syntax of such rules depends on the AHS. An example of the use of specific rules in AHA (De Bra et al., 1998) is:

```
...
<!-- if readme and not intro -->
      This text only appears if "readme" is a known concept
      and "intro" is not yet known.
<!-- endif -->
...
```

- "add-gen-pre/post-rule" are methods for creating *generic* rules. Generic rules specify how the AHS should handle events and concept relationships of a given type. A *generic* rule about *prerequisite* relationships could say:
  - When a user visits concept C and all prerequisites are satisfied the knowledge about C becomes 0.8.
  - When a user visits concept C and not all prerequisites are satisfied the knowledge about C becomes 0.5.

  This rule applies to *all* prerequisite relationships, while the above example from AHA only works for a specific instance, with two specific concepts.

If TM-Tool lets authors create their own generic rules, possibly using their own attributes added to UM, it may not be possible to automatically verify the consistency of the rules. In the current version of AHA (De Bra et al., 1998) only specific rules are permitted, using a simple and not very expressive language. While this limits the power of

AHA it makes it possible to perform the verification that all concepts (pages) can be reached from the given starting page without violating any of the conditions.

An advanced AHS will let authors define their own (generic and specific) pedagogical rules. However, in the near future (and in our redesign of AHA) TM-Tool will most likely only let authors *configure* predefined rules. In the example above, the knowledge values of 0.5 and 0.8 could be author-configurable for instance.

4. Conclusion and Future Work

We have defined authoring support by specifying three main classes UM-Tool, DM-Tool, and TM-Tool. In the class definitions we have described the data model and the support operations for authoring. The division of adaptive hypermedia applications into a *domain model, user model* and *teaching model* makes the task of authoring clearer by separating different concerns. We have also indicated the main support functions that are needed to ensure that the three generated parts are internally consistent and also consistent with each other.

We are currently working on a redesign (and re-implementation) of the AHA system (De Bra et al., 1998) which is being used at the Eindhoven University of Technology for a course on hypermedia (URL http://wwwis.win.tue.nl/2L690/), a course on graphical user interfaces (URL http://wwwis.win.tue.nl/2M350/), and a kiosk information system for students who wish to do an internship or master thesis in information systems (URL http://wwwis.win.tue.nl/IShype/). AHA is also being used for the development of a course in language learning (Calvi, 1998). AHA currently offers authors the ability to specify *specific rules* for the inclusion of fragments or for determining the desirability of links. We hope to extend AHA with the ability to specify *generic rules* as needed by richer tools for creating user models and teaching models.

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Color-Coded Virtual Reality Navigation Research Tool

Barbara Beccue, Ph.D.
Applied Computer Science, Illinois State University, USA
e-mail: bbeccue@ilstu.edu

Joaquin Vila, Ph.D.
Applied Computer Science, Illinois State University, USA
e-mail: javila@ilstu.edu

Abstract: In the rapidly developing area of User Interface Design (UID), the existing knowledge and understanding of UID serves as a basis for further research and study of factors affecting users as they interact with interfaces that utilize the technology of multimedia, virtual reality and intelligent agents. Color and navigation are two of the factors that are being investigated to help designers develop user interfaces that are effective and efficient for the users. This paper describes a color-coded navigation tool developed to support research about the effects of color on navigational decisions in a virtual reality environment. The tool, Color-Coded Virtual Reality Navigation (CVRN), allows the design and exploration of color-coded three-dimensional worlds and provides for navigational tracking. When using CVRN, the structure of the virtual world is a never-ending building composed of many empty rooms. CVRN enables researchers to customize experiments that allow for testing a subject's navigational behavior and color preferences in a virtual reality environment.

Introduction

Human Computer Interaction (HCI) especially as it relates to User Interface Design (UID) is one of the most rapidly developing subject areas in computer science and information systems. There has been a tremendous growth in interest about human computer interaction in the past two decades since the development of the personal computers, and subsequently, since the wide-spread use of computers by those outside the professional realm of computing. The study of HCI, a multidisciplinary area, has contributed substantially to the knowledge of how humans interact with computers. The results of such study have enabled the developers of computer systems to deliver products that are usable and that effectively support the user community.

Coupled with the development and discovery in the area of HCI are significant advances in technology that add to the complexity of the User Interface Design. In the last ten years, issues in UID have changed from those related to relatively simple text-based non-color screens to those related to interfaces which combine video and live images with text, sound, graphics and color. Furthermore, the user is now able to interact with the computer application system through these interfaces and UID also involves interaction issues. Currently, virtual reality and intelligent agents are also being incorporated into the user interface. Even though, the understanding of HCI has advanced rapidly over the same time span, technology has advanced to a greater extent. Consequently, HCI needs to consider the implications of new technology on the development of user interfaces. The basic knowledge and understanding that already exists regarding user interface design can provide a good foundation upon which to build a basis for research and study of factors affecting users as they interact with interfaces that utilize this new technology.

Color is one of the factors that has been researched and studied both as a physical property in the world of physics and as a factor in the two-dimensional world of user interface design. In fact many guidelines for using color in user interface design are available that aid the designer in developing user interfaces. Consequently, effective use of color in screen design has been increasing and is much more prevalent currently that it was at the beginning of the decade. Color is used to assist in formatting or organizing visual displays, to relate single elements into groups or to separate items from each other. It is used as a visual code to help the user identify or give meaning to items. It is used to attract the user's attention, to increase the display's appeal to the user and to portray natural objects. Experience with the use of color in many fields as well as that in user interface design has provided the user interface designer with much knowledge about what works well with colors and what doesn't and what the potential problem areas of color usage are. However, "There is a lot to understand about color in user interface design." (Shubin, et. al., 1996). This is especially true since the perception of color is highly subjective and is affected by both one's physical capability to perceive color and one's expectations about color use based on culture and learning or experience.

Navigation is another of the factors that has been researched in the two-dimensional world of user interface design. Interface designers have gained some insight into the navigational patterns of different groups of users based on user characteristics (Beasley & Vila, 1992; Beccue & Vila, 1992, 1994; Rendon, 1994). As designers work with three-dimensional worlds, they need to know whether the findings related to two-dimensions or to real world behaviors still apply. In reviewing literature related to navigation patterns in HCI, it was found that the research involving navigation in three-dimensional environments is concerned with research which focuses on navigational awareness, spatial ability or wayfinding (Satalich, 1995). The two-dimensional research on navigation patterns more closely aligns with wayfinding than with the other two areas.

Regian and Shebilske (1990) conducted a wayfinding study in a virtual reality environment. The environment was a virtual maze consisting of three stories with four rooms on each floor. Each of the twelve rooms contained a unique color-coded geometric object. Subjects were taken on three different verbally directed tours, then given one hour of free time to explore the environment. After this learning time, the subjects were given 3 wayfinding tasks each of which consisted of finding a specified object. They were instructed to take the shortest path to the destination. The authors found significant differences between the number of rooms visited by the subjects in each task and the number of rooms visited by a random walk algorithm for each task. While this experiment addresses the ability of subjects to learn navigational skills in a virtual environment, it does not indicate how they learn i.e. by self-exploring, by verbally guided tours or by a combination. The study did not investigate navigational patterns that might have been followed by the subjects.

Other research has shown that people do not make random decisions on which path to take at each decision point in wayfinding (Peponis, et. al., 1990). In fact, Peponis observed that people tend to avoid backtracking and to find visual vantage points or places that provide the best visual access to other areas of the environment.

One informal study investigated toolsets for wayfinding in virtual environments (Darken and Sibert, 1993). The following toolsets that were available to study participants: landmarks, flying, spatial audio markers, visual markers (breadcrumbs), coordinate feedback, grid navigation and either track-up map-view or North-up map-view. The use of the tools by subjects was examined for three different search conditions. One search condition was to explore and learn the environment. Another condition was to locate a known object. The third condition was to locate an object when information about its location was known. Through observation it was noted that the subjects used the different tools in a variety of ways and not always as expected. For example, breadcrumbs were used more often as landmarks than as a trail.

Satalich (1995) studied navigation and wayfinding in a virtual reality environment. The VR environment was a U-shaped building containing 39 separate rooms and over 500 objects. The building had some wide open spaces and other distinctive areas. Paintings and objects were located so that they could be used as landmarks. Subjects explored the building in one of the following ways: self-exploration; active guided where subject followed a pre-determined path; and passive guided where subject was moved through environment at a constant speed with no interaction. The control group only studied a map of the building; they did not explore the environment. In addition to the type of exploration, subjects either had access to a map for five minutes before entering the building or they did not. A third factor was whether or not subjects had a map during the exploration phase of the experiment.

The tasks assigned to the subjects in the Satalich study to investigate navigational awareness utilized the following three measures: orientation, route estimation and Euclidean estimations. The results indicated that having a map before entering the virtual environment improved performance but exploring the virtual environment did not. In addition subjects were given two wayfinding tasks. In the first wayfinding task, finding a room with a particular object in it, there were no differences between the control group and those in the different VR exploration groups. Those subjects who had access to a map prior to entering the VR environment performed significantly better than those who had had no access to a map prior to entering the VR environment. The results suggested that having a map during the wayfinding task may have interfered with wayfinding. Results for the second wayfinding task, finding a specific laboratory when the two main routes were blocked with fire walls, showed no significant differences across experimental conditions. However, the difference between the performance of the control group and those groups who had no access to any maps was significant. Satalich observed that the behavior of the subjects clearly indicated that decisions on which way to go were not random. Specifically she noted that "subjects, even when lost, would not backtrack without purpose."

The limited research into navigation patterns of users in virtual reality or 3-dimensional worlds raises many questions. The current research seems to indicate that navigation and wayfinding performance is not clearly understood and that more investigation is needed in order to gain a better understanding of the issues involved. Additionally, little research has been done on navigational patterns although what research is available seems to indicate that navigational patterns do exist. One factor which may affect a user's navigational behavior is color. In order to investigate how color may impact the way that users navigate in a 3-dimensional world, one needs to be able to control and change the color of the 3D environment and to track an individual user's movements through the color-coded virtual reality space.

This paper describes a color-coded navigation tool that facilitates researchers efforts in studying the effects that color may have on navigational decisions in a virtual reality environment. The tool allows the design and exploration of color-coded three-dimensional worlds and provides for navigational tracking. The structure of the virtual world is a never-ending building composed of many empty rooms. The tool enables researchers to customize experiments that allow for the testing of a subject's navigational and spatial behavior in a virtual world as color is changed.

Tool Use for Experiment Design & Methodology

In this phase of on-going research into navigational preferences of computer application users, a tool was designed and constructed that will be used to conduct research into the effect that color has on navigational decisions in a virtual reality environment. The Color-Coded Virtual Reality Navigation (CVRN) research tool will allow the user to explore a three-dimensional environment. The researcher can specify colors and track the user's navigational decisions when the user is performing an assigned task. Thus the study of color and user's reaction to it will be enabled through the use of CVRN to customize a VR environment and to track the user's actions.

The current version of CVRN incorporates the following components: the VR Environment Setup, the Demographic Survey, and the VR Experiment Interface.

The Demographic Survey enables the researcher to gather and record information about the subjects such as age, gender, level of education and national origin. The VR Environment Setup module permits the researcher to specify color distribution among the different rooms that compose the virtual world. The color distribution is determined by means of an RGB triangular model that permits multiple orientations and control for saturation and lightness. The setup module enables the researcher to place landmarks within the world to support wayfinding tasks. While the subject is navigating the environment and completing the tasks, his movements will be tracked and the time spent in each room logged. The VR Experiment Interface module is the world with which the user will be interacting to accomplish a specified task. Thus, CVRN will facilitate research efforts into the effect that color has on navigational decisions by providing a flexible tool that can easily be customized to conduct relevant experiments.

CVRN allows researchers to track navigational patterns of each subject when performing a task. Experiment designers can use CVRN to create various customized color-coded environments, to set landmarks and to prepare tasks and instruments to track navigators decisions. Analysis of data collected via the use of CVRN is still the responsibility of the researcher.

Researchers through their color-coded designs can evoke a subject's natural route decision making, if any. For example, a subject navigating the world of an achromatic design may choose a different navigational route than when navigating in a chromatic world. Within the chromatic world, a researcher could also use the tool to shed some light into the effect that hue, saturation and lightness may have on route selection.

The tool will allow the researcher to verify that color is the determining factor in route selection patterns since the color orientation or distribution within a world can be changed and controlled.

CVRN depicts a building with an infinite number of rooms, each having four doors. Each room can be set up with a distinctive hue, saturation and lightness. If the subject is free to explore the created environment, what would the navigation trail be? Are there any demographics that correlate to navigational decisions within particular color-coding (i.e., gender, age, right handedness, etc.)? Are there some color-coded designs that affect the sense of orientation more than others? In achromatic or chromatic designs, how many turns can a subject recall before complete disorientation occurs? The measures recorded by CVRN such as navigator location, time stamps, number and type of turns and landmark finding provides the researcher with electronically recorded information that will make organization, manipulation and analysis of data more efficient and accurate.

Technical Description of the Tool: Color-Coded Virtual Reality Navigation

The Color-coded Virtual Reality Navigation research tool (CVRN) is comprised of three modules: the *VR Environment Setup*, the *Demographic Survey*, and the *VR Experiment Interface*. All the modules are accessible by pull-down menus from the CVRN Main Screen. These modules were implemented using Microsoft Visual C++, Autodesk 3D-Studio, Microsoft Direct3D, Microsoft Visual Basic and Microsoft Access.

The *VR Environment Setup* includes the capability to select the color distribution based on a traditional RGB triangular color model and to place landmarks within the Virtual World. The VR Environment Color Distribution Setup Screen (Figure 1) includes the color orientation and the saturation and lightness control settings. The Landmark Placement Screen (Figure 2) includes drag and drop operation for landmark placement within the grid that represents the virtual world. The subject's starting navigation point in the world is represented by a red square in the middle of the grid. Originally, the landmark, which is represented by a blue square, is located outside the grid. This object can be placed anywhere within the grid. In Figure 2, it has been placed in the upper quadrant of the grid. One can use the arrows in the right hand side to show a path to the object. Currently, this capability is available only in the *VR Environment Setup*.

The *Demographic Survey* module is invoked from the CVRN Main Screen's Add pull-down menu. The *Demographic Survey Screen* is a form for the collection of demographic information from each subject who participates in the study. After completing the survey, the subject proceeds to the *VR Experiment Interface*.

The *VR Experiment Interface* depicts a virtual world consisting of a building with an infinite number of color-coded rooms in compliance with the *VR Environment Setup* parameters. See Figure 3.

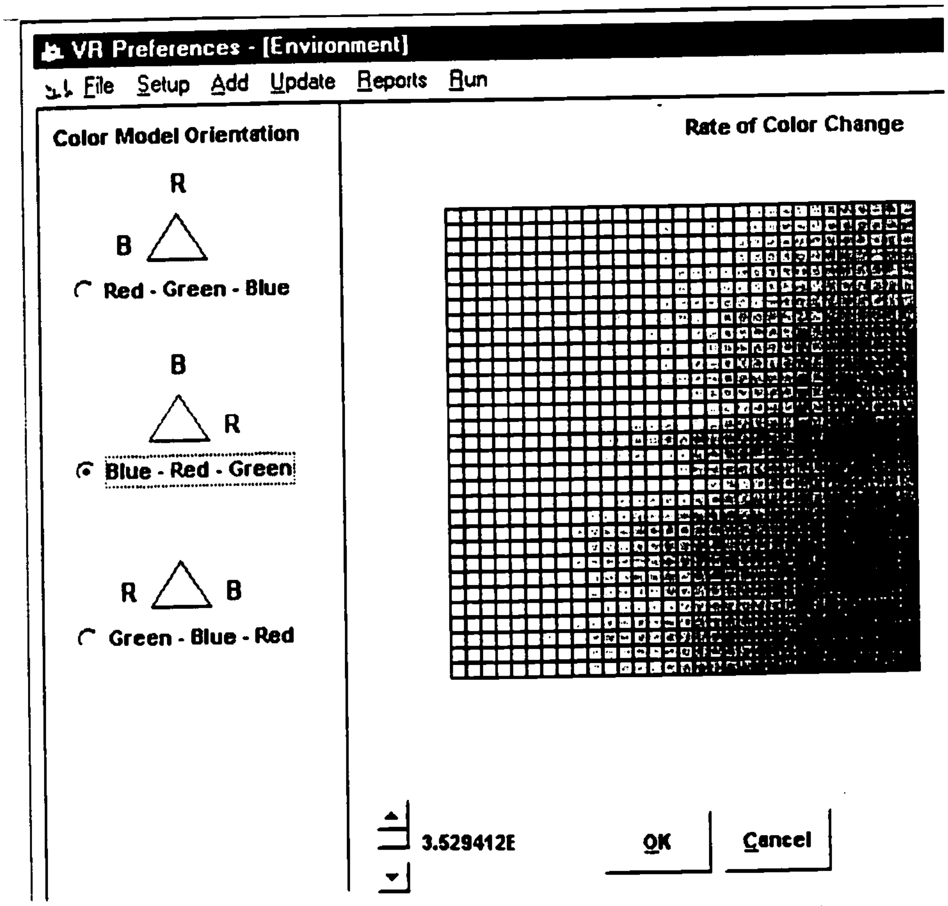

Figure 1: VR Environment Color Distribution Setup Screen

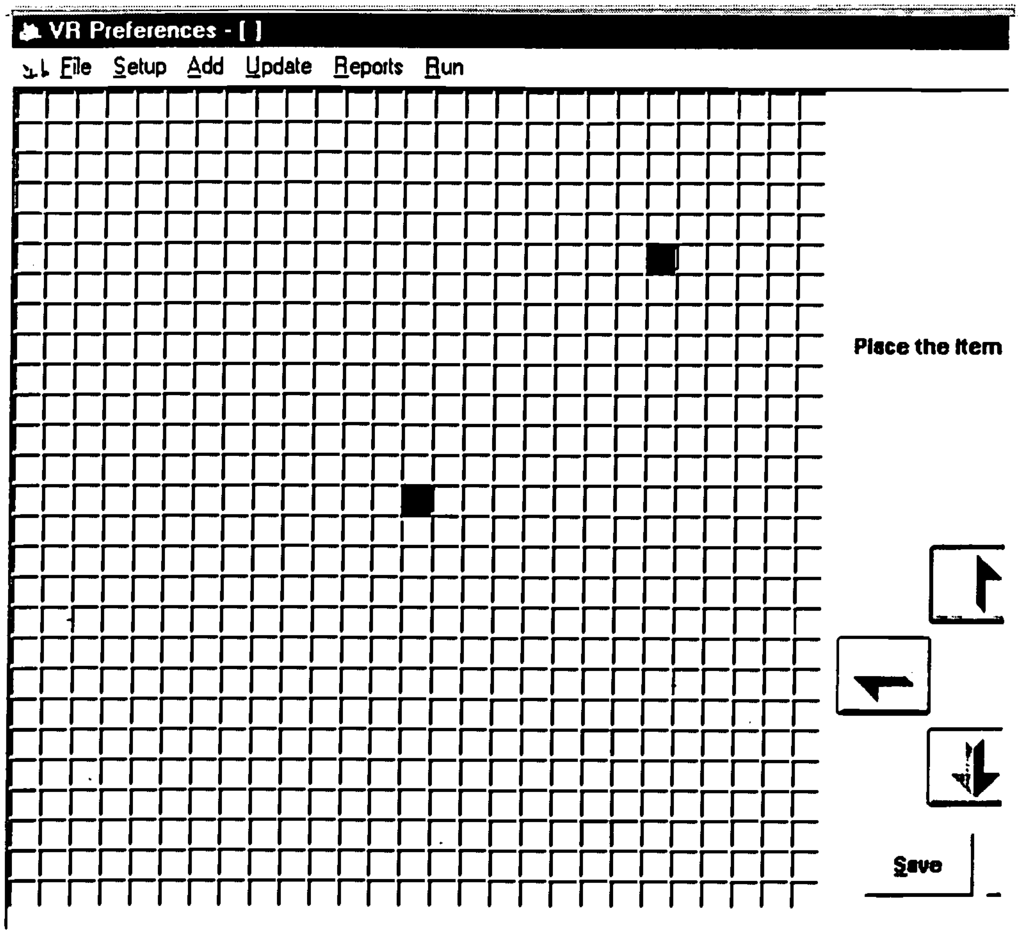

Figure 2: Landmark Placement Screen

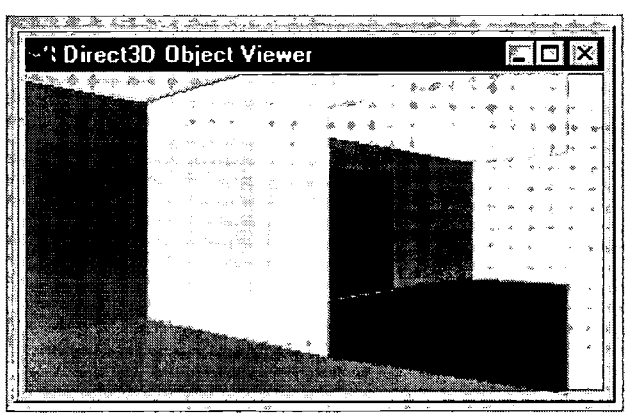

Figure 3: The VR Experiment Interface

The VR Experiment Interface supports two window resolutions: 320x200 and 640x480 pixels. The lower resolution of the VR environment can be used on less powerful machines to gain speed and provide for smother animation. The higher resolution can be used on more powerful machines to provide a larger VR field. The navigator can traverse the world using the arrow keys or look-around (rotate in the Y-axes) using the mouse. Once that the subject completes the specified task the experiment's data is saved in a database for future analysis.

Summary

CVRN was designed and constructed to support research about the effects of color on navigational decisions in a virtual reality environment. Research in this general area is hampered by the need to control or stabilize many factors while allowing the investigator to examine variables of interest and by the need to take or track many measurements of the activity generated during experiments. In order to investigate how users navigate in a 3D world, one needs to be able to track an individual user's movements through a virtual reality space when that user is attempting to accomplish a specific task. CVRN provides a template and data collection capabilities which enable the researcher to conduct such investigations in an effective and efficient manner.

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Electronic Collaborative Learning Architecture: Spanning Time and Distance in Professional Development

Richard G. Milter
College of Business
Ohio University
United States
milter@ohio.edu

John E. Stinson
College of Business
Ohio University
United States
stinson@sarhanther.com

Abstract: The Ohio University College of Business has been using problem-based learning approaches to instruction for the last 13 years. In March of 1997, the MBA Without Boundaries program was launched as a distance offering using a project-based action learning format. Participants progress through the program as a cohort and work on nine projects over the course of two years. Participants come to campus for 4 to 8 days between projects for debriefing on the project just completed and to be introduced to the next project.

Participants work in teams of four or five using Lotus Domino as the conferencing system for conducting their work. Faculty members monitor the participant work and offer two types of commentary. First, there are infrequent coaching comments offered if a team is seen to be particularly bogged down -- coaching focuses on the problem-solving tactics and group processes being employed. Second, faculty members offer project reviews offered to the entire class. This is a "how is the class doing" perspective -- commenting on similarities and differences in both strategies and the products that are being produced.

In this paper we will present an overview of the program and then focus on two issues: 1) instructor coaching and feedback and 2) participant interaction using Domino. Goals, alternative strategies, and problems in providing feedback will be discussed, with particular attention to the difficulty of balancing the felt need to "teach" the participants when they encounter difficulties with the goal of maintaining learner ownership. Participant conferencing strategies and the protocols they develop will be discussed. Both samples of their conferencing and data from interviews with the participants will be presented. For both participant conferencing and faculty coaching we will pay particular attention to how the strategies evolve across projects.

Program Overview

The Ohio University College of Business has been using problem-based learning approaches to instruction for the last 13 years. For more detailed descriptions of the evolution of the program development see Milter & Stinson, 1995 and Stinson & Milter, 1996. In March of 1997, the MBA Without Boundaries program was launched as a distance offering using a project-based action learning format. This followed over a year of development work between the core design faculty team and an external review board comprised of key individuals from corporations and learning centers. Selected participants must have at least 2-4 years of increasingly responsible positions and must be sponsored by their company. The actual average experience level in the first class begun in March 1997 is about 6 years. The average experience level for the second class begun in February 1998 is about 8 years.

The MBA Without Boundaries program uses an action-learning format with a theoretical base in cognitive constructivism, which places the learner into exactly the type of projects and work situations that he/she will face as a leader of the knowledge-age organizations of the 21st century. Participants learn basic business concepts in the context of their use, maximizing their ability to both recall and apply those concepts as they move back into the work world. Participants also develop the skills (communication, collaboration, teamwork) and the personal characteristics (initiative, creativity, personal responsibility) that are becoming so necessary for success. Participants develop a high level of comfort with information technology as they regularly access information through the resources of the internet, collaborate electronically over time and space, and develop and make professional-level computer-driven presentations.

The program targets 9 major projects. The projects tend to be large macro problems that address business holistically. Within each project are multiple smaller problems that participants must address to manage the total learning problem. Participants construct their knowledge of business practices by working their way through the problems. Participant learning is aided by the ability to access appropriate content on a just-in-time basis. Participants learn content at a time when it will be most useful to them in their management of the learning problems. While some of the problems are designed to challenge individuals separately, most of them are designed to be approached by collaborative learning groups.

While focusing on more macro problems and working with larger groups, the action-learning process employed is a derivative of Reiterative Problem-Based Learning, which was developed by Howard Barrows (Barrows, 1985), and follows closely the concepts of cognitive constructivism (Savery and Duffy, 1994) and cognitive apprenticeship (Collins et. al., 1990). (For a more complete description of our use of the action learning process, see Stinson, 1990, and Milter and Stinson, 1995.)

The program begins with an intensive one-week residency (Sunday 1pm through Sunday Noon). The participants then return to their homes and work assignments not to see each other again for 3 months. After 3 months of online interaction and collaboration, program participants meet for an intensive weekend (Thursday 1pm through Sunday Noon). Each project begins and ends in a residency. Participants progress through the program as a cohort and work on nine projects over the course of two years. Participants come together every three months during the two-year program; three extended weekends and one full week each year.

The faculty team, in regular consultation with the external review board, designs seven of the nine projects. Two of the projects are individual projects where participants design and implement projects of personal interest (these projects often benefit their company). Each project is developed to meet specific learning outcomes. In order to provide a foundation for the total program design, meta outcomes are developed by faculty members in discussion with executives and futurists. Content-to-action outcomes are more specific learning goals that participants need to learn in order to fulfill project expectations. The meta outcomes and content-to-action outcomes for the MBA program are as follows:

Meta Outcomes
(Approached through total program design)

A holistic understanding of business and the environment in which business functions.

A degree of technical expertise, but not a sub-optimal functional orientation.

Knowledge of current business practices and factors influencing those factors, but not knowledge alone. The ability to apply the knowledge effectively is critical.

A proactive orientation with the ability and self-confidence to take initiative and function independently.

The ability to tolerate ambiguity and the ability and self-confidence to clarify own role through normal interaction with others, internal and external to the organization.

The ability to manage self - time, resources, priorities, stress.

Communication skills, with particular emphasis on the ability to communicate ideas succinctly in oral form and electronically. While traditional report writing remains important, it will be less so in the future.

The ability to work effectively using electronic information technology.

The ability to collaborate effectively - the ability to influence others and be influenced, to listen and understand, to work out differences so they do not become destructive conflicts, to use diverse perspectives, cultures, and expertise to maximize effectiveness.

Content-to-Action Outcomes
(Approached through multiple projects)
Analyze an industry and develop a reasonable foresight for the industry.
Collect competitive intelligence, analyze emergent strategy, and determine competencies, strengths and weaknesses.
Analyze a company, identify important competencies and propose what the company should do now to compete effectively in the future.
Identify a market (customer value added) for a new technological development
Develop a proposal to a venture capitalist to obtain capital for a new venture.
Develop a business plan to effectively implement a new venture.
Select, from among alternatives, the most promising of new ventures.
Develop a program to develop and bring a new product or service to market.
Identify an appropriate manufacturing system and prepare a macro design of the system.
Analyze a process and propose a redesign that minimizes waste and maximizes quality.
Select from among alternatives, the most appropriate operational improvement techniques or programs, and design the implementation strategy.
Develop global sourcing strategies and programs.
Define a market, identify demand determinants for a product or service, and estimate demand.
Determine and appropriate price for a product or service.
Develop and implement a promotion strategy and program for a product or service.
Create, interpret, and use financial statements
Analyze cost structure and determine cost of products and services, using different cost accounting approaches (full, marginal, ABC).
Using ratio analysis and other appropriate techniques, determine the financial strength of a company.
Determine capital needed to support business activities and determine how to best obtain that capital.
Demonstrate sensitivity to the disparate cultures, values, and behaviors of non US business
Perform country analysis, determine potential for products and services in non-US countries, and identify appropriate modes of entry.
Operate effectively within the complexity of global, simultaneous domestic and international, business operations.
Identify and consider significant foreign trade issues, including laws, regulations, and currency exchange.
Perform basic business research, primary and secondary, using appropriate resources.
Incorporate ethical and social issues in process of making business decisions.

Each project has a set of "content-to-action" learning outcomes that are specifically linked to actions required during the projects. These outcomes are shared with participants and jointly agreed upon at the outset of each project during the reiteration on the first day. For the two individual projects participants develop a set of personal learning outcomes they wish to target.

Online Collaboration and Learning

During the 3-month span between the residencies participants, faculty, and outside resources collaborate online. Lotus Notes Domino is the software used to provide a platform for teams to work together and faculty to interact with the teams, individuals, and other faculty. Most faculty members initially believe it takes a lot of time to do it well. In actuality only 30 minutes per day checking on the database is usually sufficient to read entries for a class of 25 participants. It may take a bit longer to respond to many entries. Faculty members find that they must keep up or the entries can pile up.

Like other forms of groupware, Lotus Domino offers key enablers to assist with the collaborative work of learning. The elements of groupware as described by Lotus (1995) suggests that it must combine three essential elements to be viable:

- A reliable, scaleable and secure distributed document database. The database-centric model gives users the ability to assemble, share, and manage the rich variety of documents vital to conducting business --business plans, contracts, orders, product information, calendars and to-do lists, multimedia presentations, faxes, scanned images and video clips.
- An integrated messaging system. Groupware users must be able to take advantage of a messaging infrastructure to send and receive electronic mail and move documents through a workflow process.

- A rich application development environment. Developers must be able to rapidly build portable and scaleable strategic applications, which span document-oriented and structured database information.

Although most of the previous use of Domino has made use of its ability to serve as a document database, the integrated messaging system and application potential is being presently evaluated for future use. The present configuration of Domino for the MBA Without Boundaries program contains two major sections: common and project-specific databases.

Common databases are available on the Domino Intranet Homepage include:

- announcements (information about the program in general),
- address book (with pictures and information on participants and faculty),
- general discussion (about non-project matters or tangential issues),
- learning resources (collection of selected best of the breed for knowledge enhancement),
- technology issues (trouble-shooting area and FAQ items),
- internet resources (online knowledge adding items and skills enhancement areas),
- faculty/staff discussion (private area for faculty to work together in development and evaluation).

Project databases on the Domino Intranet Homepage include:

- project discussion (specific discussion regarding the current project),
- learning activities (learning issues and questions of the week assignments for individual assessment),
- database for each team (collaboration on the current project).

The Intranet Homepage also contains links to a help document, chatrooms, earlier project databases, and the College and University Homepages.

During some projects a database for "Question of the Week" is used. In this database each week a faculty member poses a relevant question for participants to respond to during a two-week period. Responses are evaluated on the basis of their ability to move the discussion forward by adding new insights or appropriate synthesis reflections. Participant evaluation for each project is split between 40-60% on team deliverables and individual performance. The individual performance is comprised of performance on learning outcomes, reports, questions of the week, and post-project assessments.

Instructor Coaching and Feedback

Part of coaching is the ability to offer new information as needed by individual learners. During the 3-month distance period of each project, faculty members provide learning module material via "streaming video" by placing 5-10 minute clips onto the Domino database. Participants use RealPlayer to play the video, audio, and/or the PowerPoint slideshow to view these "video connect" segments. This allows individuals with various learning styles to stay in their strong suit as they digest new information. Participants can question any module material online in the project discussion database. They can view the video connect as often as they wish merely by clicking on the icon for the clip.

Another element of coaching is the provision of feedback about the process or the content being dealt with by the learners. Faculty members react to the entries made by participants in the various individual and team databases and deliver feedback on a continuous basis. Each project has a faculty member serving as the project director. The project director is responsible for tracking individual entries required in the learning issues and "question of the week" databases. Each team is assigned a faculty mentor who is responsible for tracking the team's deliverables during the project. These activities also occur via the Domino databases.

Another area for coaching is in the learning issues database. As learning issues are defined, they are stated as questions. As participants find information and draw conclusions related to the learning issues they make entries in the database. These are reviewed and all participants and faculty members can express comments. These entries are one source of evaluation of participant learning.

Participant Interaction Using Domino

Participants use the various databases to submit information, ask questions of faculty and outside resources, discuss issues with colleagues and faculty, socialize, and collaborate in their project teams. After a couple of days most individuals become adjusted to using the asynchronous mode of interaction provided by the Domino database for these activities. There are, of course, times when synchronous discussion is preferred. When the team members need to reach consensus about a future direction or the value of a specific timely piece of information, it is advantageous to meet together at the same time. The database contains links to a chatroom (Microsoft's NetMeeting) that allows a team to hold a synchronous session. The chat software records these sessions and the chat log is placed in the team's database for tracking and archival purposes.

The Domino database allows participants to move quickly through various discussion, teamwork, data sources, chat, and other areas of collaboration. It allows participants to sort by topic, date, person, or category. It also allows for searching by key words. Because it is on the web, URLs that are entered immediately become hotlinks to the source sites. This makes it convenient for sharing detailed information on an "as needed" basis. The ability to function on an "as needed" basis is pervasive in the learning approach used by the MBA Without Boundaries program. The use of this web technology enhances the ability to deliver learning modules, information, tutoring, coaching, instruction, and collaborative space when the learner needs them. Recognizing the differences in learning and living needs among a group of learners, it would be difficult to offer such a program without the support of a software tool like Lotus Domino.

Reflections from MBA Without Boundaries Graduates

One recent graduate expressed the following reflections ... The MBAWB program has provided an opportunity to define and develop my individual and business competencies necessary to compete in today's challenging business environment. For the past two years a virtual relationship among twenty-one individuals has been established.

Sharing personal knowledge and experiences has provided a unique learning experience. It has changed my perception of how I learn. This was a struggle initially because of past industry and organizational cultural experiences. Being able to trust and share ideas on team projects that offer solutions to complex problems has been truly enlightening.

During the course of the program we have completed nine projects. Seven of the projects were team orientated and the other two projects conducted individually. These projects have provided the framework for a continuous learning process that will remain with me for a lifetime. The combination of participating in concept discussions, learning issues and assigned projects has enhanced my skill set and self-confidence to a level that will allow me to achieve my desired goals.

This can be best demonstrated by the project outcomes presented to third party clients involved with the Global Account Organization and Euro Currency. These dynamic learning experiences are unsurpassed and provided me with a tremendous amount of confidence.

Furthermore, the reflection process provides an opportunity to assess the past two years and quantify those competencies that were learned and will make me an effective business professional. First and most exciting to me is the development of my technical competencies. Turning on the computer was about the extent of those skills before entering the program. To elaborate, my ability to utilize MS Word, Excel and Power Point software is definitely a milestone. In addition, I am intimately involved in the startup of a computer product and service company with the purpose of positioning it to take advantage of the electronic business revolution transcending today's business and economic practices.

Another recent graduate offered these reflections ... The hard stuff is not the hard stuff. Actually, the soft stuff is the hard stuff. The hard numbers are scorecards documenting how well you managed the soft stuff. People are the ultimate challenge in business. How do you motivate them? How can you minimize distractions? How can you encourage them to adapt continuously? How can you persuade them to be loyal when the commitment is not returned?

Leadership still matters. The forest and the trees both matter. Even at the tree level, leaders must instruct, encourage and persuade. As information proliferates, someone must decide what is more important and which priority is next. Effective organizational leaders produce other effective leaders. Ineffective leaders stifle the entire organization.

Technology is a double-edged sword. Technology both raises and lowers barriers. Technology is a wonderful place to hide. Technology is a kind of wind tunnel. Whether one flies or crashes depends on how well one is designed.

Learning is the easy part. The challenge is in the doing. Asking the right questions is important. And figuring out what they are is no piece of cake.

Conclusion

We began working with this innovative and evolving platform for learning 13 years ago. At that time we made the commitment that if we ever thought we had it right it would be time to get out of the business. We do not believe we have it right. We have never offered the same program two years in a row. At each residency we hold a feedback session with the participants with the goal being to improve the program. We keep an open discussion in our databases for the same purpose. We are constantly searching for better ways to assist learning.

It is not easy to find faculty members willing to step out on such an ambiguous and often tenuous platform. When we do find them we cherish their involvement as much as they fully cherish the experience. Participants in the program, including faculty members, gain first-hand experience in what it takes to develop a true learning community. These experiences usually transfer immediately to other learning situations. It becomes a true spiraling of knowledge and learning how to learn.

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Structured Information and Course Development: An SGML/XML Framework for Open Learning

Prescott Klassen
Open School, Open Learning Agency
4355 Mathissi Pl.
Burnaby, BC, Canada, V5G 4S8
pklassen@openschool.bc.ca

John Maxwell
Open School, Open Learning Agency
4355 Mathissi Pl.
Burnaby, BC, Canada, V5G 4S8
jmaxwell@openschool.bc.ca

Solvig Norman
Open School, Open Learning Agency
1117 Wharf St.
Victoria, BC, Canada, V8W 1T7
snorman@openschool.bc.ca

Abstract: Over the last 3 years, the Open School, a service of the Open Learning Agency focussing on K-12 curriculum, has undertaken a comprehensive project to develop an end-to-end course development and delivery framework based on SGML/XML. This paper discusses the scope and direction of the project and outlines the processes involved in developing an Open School course, from Instructional Design to delivery in multiple media. Benefits of the approach and implementation issues are examined.

Introduction

Open School, a service of the Open Learning Agency focusing on K-12 curriculum, provides distance education courses and resources for students in the province of British Columbia, Canada. Traditionally, Open School has produced print-based correspondence courses. However, over the past five years, we have experimented with distributed learning technologies including proprietary client-server applications, web-based course delivery, online student collaboration, database-driven competency-based systems, and immersive virtual environments.

We have learned that to meet the needs of an ever expanding and changing client base, Open School must embrace new models of delivery and services beyond our core business as a producer of correspondence courses. Open School courses and resources need to be more flexible in their assemblage, customizable for individual clients, portable across different media, and accessible to as many students as possible.

The critical issues facing Open School with regard to developing courses for alternate media, different types of learners, and varied instructional contexts are cost and time. It is simply not practical to produce a unique course for every combination of learner, delivery environment and instructional context.

Features of a New Framework

In 1996 Open School began work on a new framework for course development and delivery. The initial list of desirable attributes included the ability to:

- create courses from Instructional Design to delivery
- create assessment types and mechanisms
- identify, associate and categorize resources within the course architecture
- create custom views of materials for different types of learners
- store and manage parts and pieces of course materials
- create a user-defined catalog of the parts and pieces of courses
- output to both print and web, as well as to other media

In 1996, there were no "off-the-shelf" products that could address this list in its entirety. Open School proceeded with an internal research and development project to create a solution.

One of the more important innovations in publishing and knowledge management today is structured information, specifically SGML (Standard Generalized Markup Language: ISO 8879-1986). In the summer of 1996, Open School's Research and Development team began work on an SGML-based course development and delivery framework.

This project was completed in 1998. As a result, Open School decided to pursue a structured information approach to course development and delivery. At that time, few educational institutions were moving in this direction. We saw this as a competitive advantage, an opportunity to innovate and inform. The emergence of the XML standard in late 1997 further validated our approach.

Structured Information Standards

SGML is an international standard for text and document processing. It is a *metalanguage* that provides a common syntax and notation to create specialized markup languages for specific domains—in our case, distributed learning. Any markup language that conforms to the standard can be used with a wide assortment of SGML/XML tools and applications.

A goal of an SGML-based markup language is to explicitly define the structure of documents. This allows computers to recognize structural components and metadata in a document, structures that traditionally have only been *implied* by presentational cues. For, example, in most documents, a **glossary term** might be identified by presenting it in bold or italics. To the human viewer, this convention is easily understood. But for a computer there is nothing significant about this string of characters apart than the fact that its is bolded or italicized, which may also be the style used to delimit an author's name or the title of a work. In an SGML document, the glossary term would be delimited by an explicit *tag*. This tag informs the computer that it has encountered a glossary term, which can then trigger specific processing of this data. For example, in print we may wish to collect all glossary terms and present them at the beginning of a lesson. If the same document is published on the Web, specific processing for glossary terms might enable hyperlinking each occurrence with its corresponding definition in a database.

The formal separation of content from presentation allows content to be presented in multiple media from a single source. The styles used in a specific medium are applied to the structural or semantic tags only in final presentation. The content is not bound to a specific presentational format and can be repurposed with greater ease.

Other emerging standards influenced the design of the Open School course development and delivery framework. Many Open School courses refer to or include various learning resources. In order to classify and categorize resources in our materials, we needed robust structures for managing metadata. We looked to and were inspired by the Dublin Core metadata set. We found, however, that local extensions were required to describe the wide variety of resources in our course material.

Similarly, the IMS Project's metadata work was another standard we looked to for insight. Although the IMS metadata standard is well thought out, it had yet to be realized in SGML or XML. We have and will continue to incorporate IMS metadata mappings to our own metadata structures.

Finally, the new XML standard itself promises those of us with SGML assets the ability to easily interchange content with others. But XML has drawbacks that result from its "newness"; parts of the XML family of standards are yet to be finalized. While this does not inhibit our use of XML for basic needs, it does restrict its use for the more complex requirements of our documents and overall system, which are better addressed today by the more venerable SGML and related ISO standards (like Hytime and Topic Maps). This will undoubtedly change in the near future and we are preparing ourselves to move entirely to XML when possible.

The Open School Graduation Program Project

The Open School R&D team spent much of 1997 and 1998 developing and prototyping the new course development and delivery framework. In 1998 Open School decided to implement the new framework with 14 grade 11 and 12 courses as part of a new initiative called the Open School Graduation Program (OSGP). The program is designed to provide high-school students with enough credits to earn a high-school diploma, working entirely online or in print.

The development group consists of 30 people: a management team, a collection of writers, production staff, Instructional Designers and a small technical team. We have identified and deployed software tools and environments for authoring, middleware processing, and delivery. Some of these tools include Adobe FrameMaker+SGML, AIS Balise, Microsoft Internet Information Server 4.0 and Microsoft SQL Server.

Process

The following outlines the basic process of bringing a new course into the SGML/XML framework, from Instructional Design through to delivery in multiple media. The process is composed of four overall phases, which are decomposed into a number of incremental stages.

Phase One: Requirements Capture and Analysis

For each course, a small team is gathered to address the business case, collect requirements, and prepare for the Instructional Design phase. The most important document we begin with is the British Columbia Ministry of Education's *Integrated Resource Package* (IRP). It is a document that outlines provincial standards for curriculum, assessment strategies, instructional strategies, prescribed learning outcomes, and recommended learning resources. Because its primary audience is in-classroom teachers, the IRP needs to be reviewed and localized for distance education. At this time we also review existing course material, technology standards, and feedback from the field.

Completion of Requirements Capture and Analysis Phase

The requirements capture stage provides the initial inputs to the next phase, the development of a highly structured Instructional Design Plan. Initial learner profiles are identified at this stage: baseline attributes of learner motivation, level of instructional support and technology access, informing the ensuing development by establishing determinants for alternate assessment and instructional strategies as well as providing criteria on which to determine the appropriateness of resources.

Phase Two: Instructional Design

An SGML Document Type Definition (DTD) supports each individual stage in the Instructional Design phase. An SGML DTD is the formal set of rules and element definitions that govern what structures are allowed or required in a document.

Stage One

The first stage of Instructional Design involves creating a robust outline of the course according to an SGML Document Type Definition (DTD). The course outline consists of a hierarchy of major subjects or topics, abstracts for content to be covered, and facets or themes (important subtopics that may pervade the course but are not represented in the major subject/topic hierarchies). The initial Instructional Design DTD requires a four level hierarchy of *nodes*: Course, Module, Section, Lesson. Learning Outcomes are positioned at the section and lesson level to serve as determinants for formal and informal assessment.

The Stage One Instructional Design Plan is an idealized mapping of subject/content and learning outcomes. It does not mean that this hierarchy is the only "view" of the course a student will see. It is however, a solid foundation on which to build materials that can be reassembled during presentation and delivery.

Stage Two

Stage Two of the Instructional Design phase involves resource identification and association. Relevant learning resources are identified and associated with the overall course architecture created in Stage One. Where appropriate, resources are further decomposed by annotation, describing their scope and relevance to particular nodes in the course hierarchy. This stage allows many different resources, textbooks, articles, online links, video clips and CD-ROMS to be appropriately situated within a course.

Stage Three

During Stage Three, assessment strategies are designed for both formal and informal assessment at the section and lesson level. Each assessment strategy is written for one or more learner profiles. They allow Instructional Designers to indicate resource dependencies and declare the type of assessment to be used in the activity or assignment.

Exit criteria for this stage requires all sections and lessons to contain assessment strategies for all learner profiles designed for the course. Designers are encouraged to develop multiple alternatives for each profile if the schedule allows.

Stage Four

An optional fourth stage (in development) of the Instructional Design process is intended to provide designers with the opportunity to develop alternate instructional strategies at each level of the course hierarchy. This stage facilitates:

- Alternate subject/topic hierarchies at all levels
- Custom sequencing of materials (requires existing structured content)
- Custom assembly of materials for specialized learner profiles (i.e. learners with special needs)
- Experimental approaches to learning

Completion of the Instructional Design Phase

The completed Instructional Design Plan, an SGML document, literally becomes the supporting framework for course authoring. All of the information in the design plan is included in the authoring environment. This ensures that the authoring process is tied directly to the original specifications laid out by the Instructional Design team.

Phase Three: Course Authoring

As with the Instructional Design phase, the Authoring phase is supported by an SGML DTD for every stage.

Stage One

Assignments and activities are developed in response to assessment strategies articulated in the Instructional Design plan. Authors create assignments and activities from standard architectures defined in the Authoring Document Type

Definition. Criteria for assessment (answer keys, marking rubrics, feedback mechanisms, etc) are required and therefore incorporated in the architectural template for activities and assignments.

Stage Two

In Stage Two, topic explorations are created based on the Instructional Design specifications for each lesson. Topic explorations are composed of text, graphics and multimedia elements appropriate for one or more learner profiles. Alternate topic explorations are encouraged for each lesson.

The result of Stage Two is a collection of peer topic explorations and activities written for one or more learner profiles. At this stage it becomes possible to select the appropriate topic explorations, activities and resources for an individual learner profile from the overall course architecture.

Stage Three

Overview material and front matter are created at this stage. This may include learner profile-dependent advance organizers, transitional components, and support materials.

Stage Four

An optional fourth stage (in development) provides authors the opportunity to address alternate instructional strategies described in Stage Four of the Instructional Design document.

Completion of the Course Authoring Phase

The completion of the Authoring Phase provides Open School with a highly structured representation of a course in its entirety. In fact it is a superset of all possible course instances that can be derived by individual learner profiles.

Phase Four: Delivery

The Fourth Phase of the course development and delivery framework focuses on producing course instances for delivery. At this point in the development process, the advantages of SGML/XML come to the fore. We bring an arsenal of SGML/XML tools and techniques to bear on the structured representations of the course materials to drive rendering for presentation. Each individual SGML/XML element and its attributes are leveraged by processing tools and associated with presentational rules. Using stylesheets and transformation rules, we produce both print and online instances of each course. It is important to recognize that this process is almost entirely driven by SGML/XML programming tools and very little hand tooling is required; a single set of stylesheets and transformation rules can be applied to all 14 courses.

Implementation Notes

Implementation of the OSGP project has not been easy. All members of the team have had to revisit best practices, "golden rules" and established "ways of seeing". The technical obstacles encountered during development were minor compared to cultural ones.

Never before has Open School simultaneously produced 14 courses, let alone in one year. The pressures and constraints of this rigorous timeline have been extreme. However, without these constraints it is unlikely we could have reached the consensus required to move forward. Constraint and compromise were crucial. A case in point: during the initial research and development phase, which preceded the OSGP project, it took many months to fully agree on an operative definition of learning outcomes.

The desktop publishing mindset has been hard to overcome. In the past, Open School authors had individual control over the presentation of the materials they developed. The new approach required them to forfeit some of this control to the larger team. Standard ways of presenting course components were developed through consensus and implemented post-authoring in the production phase. In the beginning, team members struggled with this separation of content and presentation. Once they saw the published results of the first stages and how their material began to take shape in print and online, much of their discomfort was alleviated.

Benefits of approach

As we enter the final stages of the development process, the benefits of the approach are beginning to be realized. Overall, we have gained a much better understanding of what is actually in our course materials and a more intimate appreciation of both their outstanding and not-so-outstanding qualities.

A major benefit of our approach is the structural consistency evident across all OSGP courses. This consistency allows the production team to leverage global stylesheets and transformation rules for delivery in print and online.

The increased efficiency in the production phase has provided more time to evaluate the overall quality and design of our course materials. Because we produce a published product at each stage of Instructional Design and authoring, the opportunities for formative evaluation and field review are many; no longer do these activities have to wait until the course is fully-formed.

A common vocabulary for course components and Instructional Design elements has greatly improved communication across teams. Instructional Designers, course authors, management, and production staff now have a common framework for workflow management.

We have yet to realize the full potential of our collection of structured course materials. In the future we anticipate being able to produce new products and services from this collection. The ability to repurpose will extend far beyond this year's print and online instances.

The Future

In the next year, we will be acquiring an SGML/XML object repository to manage and store our SGML/XML courses. This will provide us with all of the benefits of a database as well as an environment optimized for SGML/XML documents.

The advent of XML-enabled browser technologies like Internet Explorer 5.0 will allow us to deliver our structured content directly to the Web. In the coming year we hope to leverage this technology to provide an online environment for our clients to create customized instances of our courses tailored to their individual needs.

Work will continue on OSGP courses after delivery in September. The superset of course components will grow to accommodate additional learner profiles and instructional strategies. It is our intent to move to an evergreen revision cycle for the new course development and delivery framework.

In the coming years, we anticipate that the establishment of metadata and markup technology standards in education will allow us to integrate and exchange our structured course content with other institutions and organizations. We feel we are well positioned to take advantage of these opportunities.

Video Streaming Medical Grand Rounds: Convergence of Real Time, Any Time, WAN and Internet Delivery
(An early implementation of an important distance-learning technology)

Jonathon D. Levy, Amelia Ellsworth
Cornell University Office of Distance Learning
DistanceLearning@cornell.edu

Abstract: Distance-learning programs commonly characterized as being either synchronous (real-time) or asynchronous (on-demand), video or Web-based, traditional or non-traditional are now blending one into the other. A single word—"convergence"—now characterizes the cutting edge of distance learning, allowing pedagogy to fully drive the selection of technology and distance-learning formats. In the following pages, we will discuss the issues of interactivity, flexibility, integration, and isolation in the context of various synchronous and asynchronous technologies. We will describe the recent solution Cornell University has discovered by using NetShow video streaming software in combination with HTML Web frames and PowerPoint. By merging these media, Cornell can deliver Medical Grand Rounds over local and wide area networks in both real time and any time scenarios, combining video with Web-based presentation and a traditional format with a highly-unconventional delivery format. The presentation will feature a demonstration of Grand Rounds. Two of these demonstrations may be viewed on the Internet at: http://www.dl.cornell.edu (select "courses").

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This is a report of an early implementation of an important use of technology; however, no empirical examination has been conducted. Only anecdotal evidence is reported herein.

This program may be viewed on the Web at
http://www.microsoft.com/windows/windowsmedia/techshowcase/ (Microsoft site; select "Streaming Media and Synchronized Events" and scroll down)
or at http://www.odl.cornell.edu/pr/cumc/default.htm where the presentations may be viewed at three different bandwidths.
The Media Player may be downloaded at http://www.dl.cornell.edu/download.htm.

The Problem of Distance: spatial and temporal

Cornell's Weill Medical College is located on the Upper East Side of Manhattan. There are 4,500 doctors affiliated with twenty Cornell-networked hospitals within the five boroughs of New York who need to attend Grand Rounds presentations—updates in the various fields of specialty—at the Weill Medical College. Grand Rounds are traditionally conducted as a lecture presentation by top medical doctors. The lectures, accompanied by 35mm slides, focus on the latest developments and breakthroughs in medicine. It is very important that practicing physicians at these hospitals attend those Grand Rounds, but the physicians are scattered amongst the 20 hospitals, and it is difficult for them to attend the Grand Rounds in person.

For this particular application, time shifting proved far more important than space shifting. For most doctors, travel time plus presentation time results in a lost half-day of office and/or hospital time and very few are able to take advantage of the Grand Rounds opportunity. So Cornell began using the streaming components of the Windows Media technologies to deliver the lectures. The Microsoft Media Player software runs with any web browser on a Pentium machine with at least 32 Megs of Ram. A Macintosh solution is now available in Beta.

The Grand Rounds were initially offered live on the Internet to participating physicians and were archived for asynchronous access, so that physicians could watch them at a later time at their convenience. Interactive technologies were developed to allow doctors to "converse" with the presenter during the synchronous version, using a "mailto" button on the Web page for e-mail messages. However, initial experience showed that none of the doctors was interested in a synchronous presentation when an asynchronous alternative was available, so synchronous delivery was dropped, and the entire Grand Rounds series was offered only asynchronously.

Each Grand Round lasts about an hour. It is extremely important for the physicians to be able to see the 35mm slide image and to hear the presenter's voice very clearly. Cornell synchronizes PowerPoint presentation slides with the actual video. The slides appear in a separate window on the same screen. As doctors watch a presentation they not only see and hear the presenter, but as the presenter's image changes on the screen in the presentation room, the image changes on the computer screen of the person who is watching at a later time and at a distance. This allows Cornell to show very high-quality images accompanying the video, such as medical slides, cells, x-rays, photographs of patients, or other medical data that the doctors need to see as the presentation continues. The Media Player is configured like a video recorder, allowing doctors to stop the presentation if interrupted, and later restart it from the point where it was paused. The video, audio, and synchronized presented image (slide) all cue up and restart automatically.

One of the defining features of a learner in a distance scenario is their separation from the origin of information. This separation can be represented by a spatial or temporal distance. Learners in these scenarios sometimes find it challenging to motivate themselves and continue with the learning process. In this case the audience for this project is a highly motivated audience for whom delivery of the Grand Rounds using distance technology was, at first, solely for convenience. The project was developed with the idea that real time and anytime/anywhere presentations gave the audience the flexibility they desired. Presentation was intentionally kept as close as possible to the experience this audience was familiar with in a traditional lecture hall. Interestingly, many of the viewers reported that the Internet distance-learning programs not only accomplished the temporal objectives, but that the quality of the presentation actually was improved with the technology implementation.

Medical Grand Rounds: Background

The Cornell University Medical College is responsible for a lecture series referred to as Grand Rounds. These lectures provide continuing education for doctors in hospitals throughout the greater New York area by providing information about recent advances in their field of medicine. Traditionally, Cornell University delivered these grand rounds to medical staff in their twelve network affiliated hospitals by requiring the audience to travel to the Medical College and sit in their lecture halls. For reasons described below, this was not an optimal solution, but until recently there was no viable alternative. With the recent merger of the two teaching hospitals, New York and Presbyterian hospitals, the number of hospitals in the network rose to twenty, increasing the challenge for delivery of continuing medical education. When the Weill Medical College began to look for a new way to deliver Grand Rounds, distance learning communications technology was a natural place to turn.

The traditional Grand Round is an hour-long lecture given by a teaching faculty in a specific field of medicine. These presenters normally speak from behind a podium in very dim light with the focus of the lecture directed towards a front screen where 35-millimeter slides are projected as each point is made. In the normal course of a Grand Round, an average of 75 slides are used. These slides can be critical to understanding the lecture and are often high resolution graphics which depict the pathology or histology under discussion. There is very little interaction between the audience and the doctor making the presentation. At the end of the hour, there is a brief question and answer session and the audience files out to complete the review paperwork necessary for their continuing medical education credits.

The Proposals

Two methods for distance Grand Round delivery were considered:

- Purchase video-teleconferencing technology for each of the 20 network hospitals and deliver Grand Rounds in real time at 384kps to all sites. The presenter would be on camera and the slides would be sent either as an image taken off the projection screen or document camera (possibly an RS232 port) and the quality would be almost as good as that in the originating room. The rounds could be recorded and played back at a later time for doctors who missed the presentation.

- Stream the Grand Rounds over the Internet using Netshow 3.0 software. This program allows an audio/video file of the presenter to fill a frame in a web page and stream at speeds as low as 28.8 and as high as 500kps while the second frame flips the slide images synchronized with the presentation. Netshow provides the ability to capture, insert, and index time references in the video file to bring up a compressed digital image (most slides are usually no bigger than 400k) at the same time the presenter is changing slides in the traditional lecture hall. These images are scanned and cached ahead of time and are actually of a better resolution and quality than the ones projected during the traditional presentation because they are not distorted by projection. The rounds can be streamed real-time at the same time as the actual presentation, re-broadcast at a later time using multicast packets to conserve bandwidth, or accessed anytime on-demand at both 128kps and 56kps, allowing both LAN and dial-up access.

The solution:

In this case, the least-expensive solution also turned out to be the most effective solution. The Media Player is available to anyone at no cost (free download from Microsoft). All that is required to "attend" Internet Grand Rounds is a computer and an Internet connection. Because doctors valued their time more than higher bandwidth (the highest being attendance at the face-to-face presentation, followed by ISDN video), the lower bandwidth Internet solution was selected. Interestingly, this solution was also evaluated as "better than being there" by some of the participating physicians. This is due to the combination of technologies that allowed access to the video, audio, and synchronized presentation material at times most convenient to the physicians.

The lack of interactivity in this solution is atypical of Cornell's distance learning applications, but for this particular program it was deemed acceptable, since the face-to-face Grand Rounds offer only a short period for questions, and these are included within the Internet streamed presentation.

Innovation in Learning Methodologies for Adult Learners: Implications for Theory and Practice

Richard G. Milter
College of Business
Ohio University
United States
milter@ohio.edu

Abstract: This paper begins via a synthesis of theories targeted at innovative practices in the field of adult learning. Following a review of the current literature, the author discusses different strategies and methods used to enhance adult learning. Separation of teacher-centered and learner-centered methodologies are examined. Environmental conditions and use of technology are also items factored into the discussion. Comparative assessments of methodologies used at educational institutions and corporate learning centers are reported. The efficacy of both specific and generic theoretical constructs is examined in light of professional adult learners and the requisite skills demanded by their career positions. In other words, what theories are best suited to carry learning practices into the future to best suit the needs of active learning professionals?

Review of Adult Learning Constructs

To synthesize a field of theories is a fairly presumptuous task today. There are probably as many theories as there are stars, and we seem to be finding more of them every day. The purpose of this "synthesis" is to recognize the key elements displayed in several cogent theories regarding adult learning. Drawing on the thinking of Rorty (1991) as well as vonGlaserfeld (1989), Savery and Duffy (1994) describe the basic principles for learning. These include recognition that: 1) understanding is in our interactions with the environment, 2) cognitive conflict or puzzlement is the stimulus for learning and determines the organization and nature of what is learned, and 3) knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings. Such principles are rooted not only in learning theory but also in innovation. Without innovative thinking our understanding would never be able to match the changing nature of the environment. All innovation must begin with an inquisitiveness that is grounded in personal cognitive conflict. And finally, innovation to be useful must at some point pass the tests of social negotiations.

Barrows (1997) has suggested responsibilities of the successful innovator beyond the creation and use of new methods for educating people. The most important of these responsibilities is that the innovation must provide a substantial contribution to the learning process for all those involved. In other words, the innovator must understand the learning outcomes (what is expected of the learner) and how the innovation relates to these outcomes. A second responsibility is that the innovator actively evaluate effectiveness of the innovation. It is not enough to get satisfaction scores from the users. The evaluation must target whether the learning outcomes have been positively impacted by the innovation. A third responsibility of the innovator is to promote the innovation through publication channels so that word gets out to other educators and learners. This activity matches the need to respond to social negotiations as mentioned above.

A final responsibility of the innovator is to remain flexible and open to change. By definition this means to continue to learn. It is too easy for innovators to begin to believe their innovation is the final piece to the puzzle. They believe that with their innovation, the light at the end of the tunnel can finally be seen as the sun on the horizon and not an oncoming train. Learning innovators must take special precaution to remain learning innovators. This means they must remain learners and not to close down channels for questioning. A colleague of mine involved in educational innovation and I made a commitment to each other about a dozen years ago that if we ever thought we were doing it right it would be time to get out of the business. When it comes to learning, the business focus concerning continuous improvement makes all the sense in the world.

Challenges for Educators

Continuous improvement suggests an unflinching drive toward flexibility and growth, or in a word ... learning. Educators might be best advised to follow Charles Handy's (1996) prescription for learning as we attempt to enhance our abilities to facilitate growth in others. His learning cycle suggests that all learning begins with an inquisitive mind (questions) that leads to the development of concepts (ideas) which must then be evaluated (testing) before a period of contemplation (reflection). This "questions, ideas, testing, reflection" process is not unlike that suggested in a more recent work, *The Power of Mindful Learning*, by Ellen Langer (1997). Langer presents methods for putting into practice a true learning focus that transcends rote memorization techniques typical of traditional teaching strategies.

Rote memorization, or learning out of context, is a way that many of us were weaned on education and learning. Some of us have gotten very good at it and have graduated into leadership positions in the education field. One question that arises out of this fact is whether we should have different learning strategies to facilitate learning in children than those we have for helping adults to learn. Although much research has been done to differentiate between the two, the verdict is still out. Although there are some differences between the learning processes of children and adults, such differences may pale when comparing the differences between adults' individual learning styles. It does appear often times that it is easier for children to learn new things (like languages and computer use). Perhaps the reason it appears more difficult for adults to learn new things is in part due to the ingrained process of learning out of context. Adults must attempt to unlearn not only substantive issues but also process methods in order to grasp new meanings.

Much of this can be attributed to the designs of educational institutions. According to James Botkin, co-author of *No Limits To Learning*, most formal schooling systems, with some notable exceptions, resist change in their objectives and style of learning and education. Botkin further suggests that "school, on a worldwide basis, is hopelessly out of date. In North America, despite widespread recognition of the inadequacy of K-12 and higher education, the response to date has been limited to 'more' for the future of what has not worked in the recent past. More hours, more homework, more science and math have been the guiding principles rather than new teamwork, focus on values, or holistic learning. No country in the world has been able to figure out how to divest itself of a system built for another age and another time and to start afresh in redesigning formal education" (Botkin, 1996).

New Learning Philosophies and Methods

Many educational institutions are doing an excellent job using an obsolete model for learning. Many leaders (including teachers) in these institutions "think of the mind as a storehouse to be filled" when they should be thinking of it "as an instrument to be used" (Gardner, 1965). Educational leaders might do much better to heed the edict of Plutarch that "the mind is not a vessel to be filled but a fire to be ignited." If educators refrained from considering the mind as a storehouse or a vessel to be filled, lifelong learning would take on a whole new significance. With it, the distinctions between learning in children and learning in adults would begin to blur. The major difference would become one of context, with adults having more experiences from which to draw ways for contextualizing learning. Of course, if educational institutions at the primary and secondary levels sought to develop learning skills in children, maturity would be measured by assessing a person's ability to refresh what they have learned and apply learning from one context to another. Adults who have experienced this approach to learning from the start might not be bogged down trying to unlearn the process methods of passive learning before joining in as an active participant in the learning process.

Some educational institutions at the K-12 and higher education levels have already begun to focus more on strategies for involving active participants in learning process in their design and delivery systems (see Barrows & Myers, 1993; Norman & Spohrer, 1996; Schank & Kass, 1996; Milter & Stinson, 1994; Schauble & Glaser, 1996; Duffy, 1994). The similarities between innovative programs in medical, law, engineering, and business schools and the innovation displayed in primary and secondary schools far outweigh the differences.

One of the key similarities exhibited in these innovative programs is a deliberate push for learner-centered methodologies over teacher-centered approaches (Stinson & Milter, 1996). This is not a recent development. In the United Kingdom in the mid-1980's business leaders and educators developed a plan to reform education which resulted in a report titled "Education 2000." Out of that report, a project was created to "shift the balance of teaching to learning; to provide a greater variety of learning experiences, and to make clear the responsibility of the learner for active participation in the learning process and for achieving successful outcomes."

With this shift comes acknowledgment that it is the individual learner (child or adult) who must claim responsibility for their own learning. No longer do these innovative institutions take on the claim for learning behavior in others. They attempt to provide an environment where a learning community can thrive. An environment where answers are not as important as questions; where getting to the answers is more important than the answers themselves. An attitude where the concern for learning outweighs the desire to imbed specific facts into the brains of others. Today, with knowledge doubling every 5 years and the half-life of most useful information being about 5 years, it seems silly to claim we can provide the requisite information for an individual's future needs as a professional or a global citizen. Today innovative institutions push for knowledge discovery, but not without also pushing for recognition of ways to apply the knowledge and the importance of updating knowledge.

The Processes of Learning

Another similarity of innovation in education across disciplines and age group boundaries is a concern for the design of educational methods. Whether you refer to it as pedagogy, andragogy, or learning methods, the question remains how to best develop ways to assist learners in their learning processes. In many traditional situations the designing of methods and processes is either done by some centralized mechanism (school boards deciding which texts to use) or "on the fly" while delivering the course (many university faculty discover creative ways to develop processes during the delivery process itself). Although neither of these approaches is suspect on the surface, the danger comes from acknowledgment that the design work is unimportant at the delivery stage.

That is, most educational institutions reward delivery of courses and programs and assume the design work is merely a precursor. Corporate learning programs, on the other hand, tend to place an equal (or sometimes even greater) emphasis on design of learning materials and procedures as they do on the systems for delivery. Such corporate learning programs will pay substantial salaries to in-house developers of learning materials and proposed delivery systems then will hire outside agents to actually deliver the programs. These external agents, though important, are hired for their abilities to facilitate learning environments, not for their expertise in the specific substantive domain. Attention to the learning outcomes and substantive domain is under the responsibility of the internal designers.

Although the design work tends to be performed within these innovative corporate educational programs, these developers make no presumption of total knowledge of substantive domain areas. Such programs regularly poll internal and external practitioners in the field to take a read from their expertise about what are the most significant learning elements for the future of their profession. In order to remain current, this development activity needs to be attended to on a regular basis. It is not a "once-and-for-all-time" procedure. It is also critical as designers seek to synthesize input from current practice that they also give consideration to what the future holds for the particular professional domain. Sometimes this means going outside the view of current practice which might have a tunnel vision perspective.

Use of Technology in Learning

Use of technology is an area that tends to be engendered outside the specific practice domain. People tend to resist change until they see the benefits. Most times the introduction of a new technology causes short-term drops in performance. This tends to be temporary but nonetheless frequently dissuades full acceptance of the technology by practitioners. And yet the use of technology is clearly linked to the development and implementation of innovative learner-centered educational programs. Recent publications give substantive examples and suggestions for inclusion of more technology in learning environments in primary through secondary schools as well as professional training programs (Hamalinen, M., Whinston, A., & Vishik, S., 1996; Schank, R.C. & Cleary C., 1996; Wilson, 1996). It is not a passing fad that there is a convergence of new learning environments and new technologies.

Although universities have often led the way to development of new technologies, they have frequently lagged in response to their full utilization. This is, unfortunately, the case as well in use of new learning technologies. According to Botkin (1996), the most promising action in reforming education and modernizing learning is to be found not in universities but in the international business community. He attributes much of the reason to the fact that schools and universities still do not have the "financial or innovative human resources" to carry out the fundamental changes required by the challenges of the future.

Impact of Corporations on Learning

Business organizations, on the other hand, have begun to see the value in investing in education for the future. As reported by Botkin in 1997, corporate universities in Europe and North America now appropriate more funds to support learning than all the world's universities combined. They are growing 100 times faster than the university world, and the lifelong adult learning they support is 25 times larger than the traditional university student market (Botkin, 1997).

Corporate sponsored programs have begun to make tremendous impact in the world of learning at the primary and secondary levels. Motorola has for years pumped money into the school systems that supply its plant in Chicago with employees. But as important as the dollars, Motorola has also formed a sensitive and reciprocal relationship with the people who lead these school systems. They are facing the changing nature of the world together and have invested time and energy as well as money into the development and learning of young people who will be the leaders of tomorrow; a few of them leaders working for Motorola. And Motorola/Chicago story is not the only example of this type of collaboration. According to a report filed in 1992 by the Committee for Economic Development, there were in the US over 140,000 corporate-academic partnerships involving 30,000 elementary and secondary schools (Dickson, 1992). Today this figure is even larger and clearly not limited to partnerships in the US.

Universities, steeped in bureaucracy, tend to be one of the last organisms to experience needed change and often get dragged kicking and screaming into the future. People in universities frequently become defensive in relationships with business people, even though it is business that awaits the products of university programs. The fact is that the business world is experiencing rapid and constant change. Organizations in that world are learning to cope, or are disappearing. University leaders must realize this fact and take responsibility for the future of either coping to survive or helping to lead our students into the world that is becoming.

A Wake-Up Call for University Leaders

Leaders in university settings must begin to appreciate the fact that they do not have a corner on the education market of the future. It comes as a surprise to traditional educators to learn that fully one-third of professional educators are at work not in universities but in corporate institutes of education or learning centers. Another one-third are in church-related education, and the balance in conventional public and private educational institutions (Botkin, 1996). It is time (in fact it may soon be too late) for university leaders to begin to find new ways to bridge learning relationships with educators in these different segments.

By "university leaders" is meant anyone associated with a university setting who is involved in adding value to the delivery of learning programs in the future. By definition, therefor, this would not include administrators busy about the job of keeping the university on a steady state following outdated mechanisms and teaching methods. It is time that professional educators in university settings act like professionals. It is time to take our mission seriously. If we are to assist in developing lifelong learners in the turbulent and uncertain world of tomorrow, it is important that they not only know things but that they are also able to act using their intelligence. Being intelligent no longer means scoring high on some quantified psychometric. Being intelligent connotes that an individual has "the ability to learn and to apply what has been learned to adapt to the environment, or to modify the environment, or to seek out or create new environments" (Sternberg, 1997). University leaders need to act intelligently as we prepare for our futures and help ready others for their futures.

It is time that we begin to question, develop and test new ideas, and reflect on the processes that we use to assist others to learn. It is time to heed the challenge of Malcolm Knowles, author of *The Making of an Adult Educator*, in that "we must become able not only to transform our institutions in response to changing situations and requirements, we must invent and develop institutions that are 'learning systems,' that is to say, systems capable of bringing about their own continuing transformation" (1995). In this way we must realize the importance of the age-old adage to "practice what we preach." But first we must reconsider what it is and how it is we are preaching. Only in this way will we be able to truly assist others in their search for learning.

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On our way to a Knowledge Community

Sjoerd de Vries
Faculty of Educational Sciences and Technology, University of Twente,
Netherlands, vries @edte.utwente.nl

Jep Castelein
Business Information Technology, University of Twente,
Netherlands, jep@castelein.net

Abstract

The quest for lifelong study opportunities is expected to become one of the main characteristics of the rapidly evolving information society. Members have to be able and equipped to acquire knowledge and/or skills in ways that fit their personal situations. To help fill this need we developed a coherent design approach of educational instrumentation as a solution. This approach is named E-study. The E-study concept refers to a socio-technical infrastructure for life long learning. Herein we will describe the 'technical' and the 'socio' parts of this infrastructure. The technical site implies the Internet, while the socio site implies situated learning. Then, we describe the project ComMedia in which we bring the E-study approach in practice. We have embedded the E-study environment in the context of Communication Studies, University Twente, Enschede. Therefore, we feel that we can speak about the application of the E-study concept in a university education context.

Introduction

As the World Wide Web grows into a serious educational medium, learning will no longer be restricted to classrooms, or in the case of companies, training institutes. The Web enables a form of flexible and interactive learning that can be very valuable. This style of learning is illustrated in Collis (1991) where it is concluded that the Web and its associated technologies may possibly become the "killer application" for "tele-learning". In our research we use the concept E-study to refer to learning and training by means of the Web (de Vries, 1997; de Vries, 1998-a). We are especially interested in the design of online study environments based on the cognitive apprenticeship approach as described by Collins, Brown & Newman (1986) and Collins (1988). In other words, we want to train students to solve cognitive problems by providing modelling, coaching, and fading in online study environments. In this paper we describe first the concept E-study, which is the basis for our design. Secondly, we will describe four key design guidelines and, as an illustration, we have provided an example of a developed online situated learning environment based on these guidelines.

The concept E-Study outlined

The E-study concept refers to a socio-technical infrastructure for life long learning. The concept of life long learning is used in a Tele-learning sense. In short, 'making connections, among persons and stored resources, through communication technologies for learning-related purposes' (Collis, 1996). In this definition, an emphasis is laid on the use of information and communication technologies. To enable life long learning the need for a socio-technical infrastructure, that is a hardware and software infrastructure embedded into an institutional infrastructure, must be filled. The E-Study concept will stand for life long learning by means of the Internet. On the Internet, teachers or study guides, are expected to prepare study tasks, guide study processes, and evaluate the study processes and results. Students, or lifelong learners, will carry out relevant study tasks in ways that fit their task contexts. The context for instruction can be a university setting, an in-service training, a specific on-task performance support, and a short training at home, etcetera. Educational instrumentation is needed for study guides and lifelong learners to carry out their tasks. Figure 1 illustrates the E-Study concept.

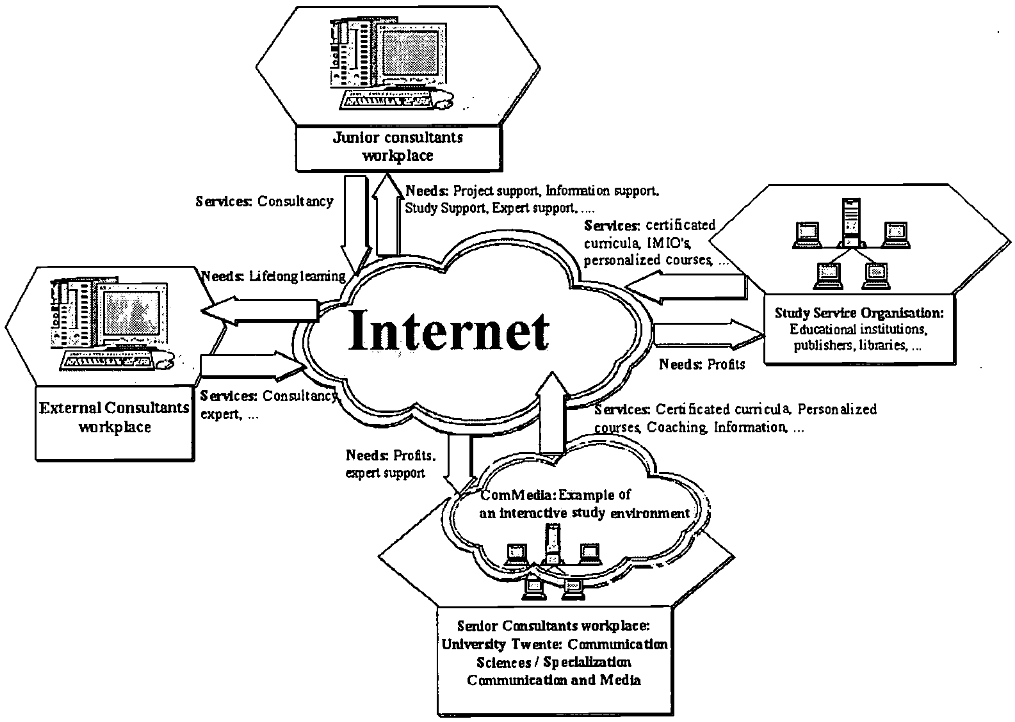

Figure 1 **An illustration of the E-Study concept**

We describe four leading principles for the design of educational instrumentation for e-study. These principles are flexibility, integration, instructional interaction, and information-enriched. We refer to flexibility as the freedom for teachers and students to determine: what to study, why to study, where to study, when to study, how to study, and who will be involved in the study process. The second principle is integration. This principle is related to flexibility. While flexibility implies diversity, integration means unity. Integration refers to consistency and coherence in the provided educational instrumentation. By instructional interactivity we mean interaction, as an input/output process between one or more users and a software program, purposefully intended for knowledge acquisition and incorporation in a broad sense. The fourth principle is information-enriched, which basically means that all relevant 'curriculum' information is provided. The information society provides members with an enormous amount of information. Members must be able to find applicable information and make use of it in a proper way. Informative as a design principle implies that users are enabled to find and use applicable information locally as well as globally. We use the concepts Interactive Study Environments, Interactive Study Systems, and On-line Study Services to describe the E-study concept (Vries, 1997, Vries & Vogel, 1997). These concepts refer only to a technical infrastructure. In the start we referred to a socio-technical infrastructure for life long learning. The described technical infrastructure has to be embedded into an organisational infrastructure. In this paper we will further discuss the 'socio'-part of the infrastructure.

An educational organisation as a context for situated learning

Our main interest involves the design of online study environments which enable situated learning. We see situated learning as 'learning knowledge and skills in contexts that reflect the way the knowledge and skills will be useful in real life' (Collins, Brown, & Newman, 1986) and as 'learning tailored and tuned to a particular situation'. If we combine both descriptions we have a clear view of life long learning. The first part refers to learning in an educational organisation, while the second refers to learning in non-educational organisations. Such learning is from the learner's point of view continuing education. The main issue for both kinds of organisations is that they consider themselves as a learning organisation, 'an organisation that is continually expanding its capacity to create its future' (Senge, 1990). Clearly, situated learning reflects our ideas of the 'socio' part of the E-study concept. Here, we will discuss situated learning in educational organisations. In de Vries (1998 b) we describe design guidelines for online study environments for non-educational organisations.

We took the cognitive apprenticeship approach from Collins, Brown, & Newman (1986), or to be more specific, their framework for designing learning environments as the starting point for the design of online situated learning environments. Their framework describes four characteristics of such environments: content, sociology, methods and sequence.

In the project known as ComMedia, we designed an online 'virtual learning company' as a 'real life context' for study projects. Figure 2 illustrates the design of ComMedia. These study projects were for students who desired to become specialists in the design and implementation of interactive media applications for corporate communication. ComMedia is part of Communication & Media, one of the six specialisations of the study program Communication Studies, University Twente, Netherlands. A specialisation it is the subject in which a student specialises in the final period before graduation, comparable with a major. The field of interactive media and corporate communication is the subject of Communication and Media.

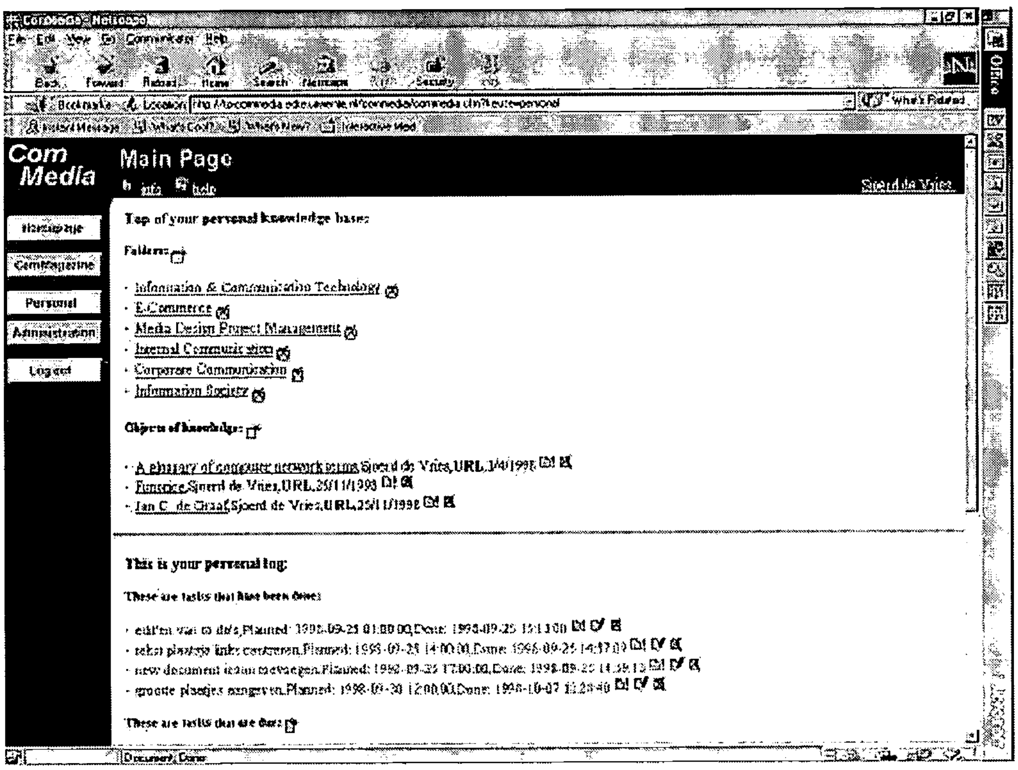

Figure 2 The personal workspace of a student in ComMedia

ComMedia as a technical system, is a website on a Microsoft NT Server. We are using Cold Fusion from Allaire as the development platform. Cold Fusion is a rapid application development system for professional developers who want to create dynamic Web applications and interactive Web sites. It provides a fast way to integrate browser, server, and database technologies into powerful Web applications. ComMedia can be considered as an infrastructure for project education. Almost all the information is stored in a database. For our database platform we are using Microsoft Access . We use the term infrastructure because ComMedia can be easily adapted and configured for another educational context, for instance for the knowledge domain 'management' in higher education. We will now discuss examples of how we applied the framework of Collins. Brown, & Newman for the design of ComMedia.

Content

The characteristic content refers to domain knowledge, heuristic strategies, control strategies, and learning strategies. ComMedia is comprised of insight, knowledge, and skills in the design and use of interactive media for Corporate Communication. The basic design guideline is that relevant 'domain' content has to be stored into a knowledge base. This knowledge base must enable the internalization, externalisation, socialisation, and combination of four modes of knowledge conversion described by Nonaka & Takeuchi (1995). In ComMedia we call this knowledge base the Cabinet. The Cabinet is a repository or in other words a mine of information. Basically we distinguish five knowledge objects and identify five knowledge object types. These knowledge types are information fragments, persons, groups, projects, and competencies. Information fragments are media products containing distinct messages. Examples include documents, links, multimedia files, and WebPages. Persons are the members of the expertise center. Examples of member roles include junior consultants, senior consultants, external consultants, editors, managers, and maintainers. Projects are dedicated workspaces, for example personal, design, research, and consultancy workspaces. Groups are people who share a certain interest without a distinct project goal, specific resources or deadlines. Examples of such groups are newsgroups, discussion groups, and special interest groups. Competencies are sub knowledge-domains. Examples are divisions, competence centers, and courses. Each knowledge object is described by a profile. The profile characteristics we describe are for instance: identification, domain themes, domain keywords, applicability, and accessibility. Identification describes generic, ownership, and author information of objects. A domain theme describes the main subject areas to which object are related. In general, there is a hierarchical order of themes. Domain keywords describe the central concepts in a knowledge domain to which objects are related. Generally, there is a network of central concepts. Applicability describes the usability of objects and refers to the forms in which objects may appear, for instance in an online magazine, portfolio, showcase, project, or internal report. However, applicability also refers to peoples' opinions about the value of objects. They can grade objects and present their opinion in words. Accessibility describes the availability level of objects. We make a distinction between the individual, project, competence, internal, and external level. A specific object available on the individual level means that it is part of a personal archive. However, that person can make the same object part of a certain project archive, etcetera. Based on these characteristics, it is possible to create a characteristic profile for each individual knowledge object. In the very near future, it is expected that these profiles will be 'built' dynamically, based on the persons behavior. That means that for instance, persons' profiles, and more specific the description of the persons' competencies, are updated continually. This update will be based on the study activities a person performs. The strategies are translated into task objects and a set of these objects form workspaces. Task objects are for instance: archive, personal management, design, and study. Examples of workspaces are the personal workspace, the study project, and the design project workspace. Each workspace is formed dynamically, based on the personal profile.

Sociology

Sociology is characterised by situated learning, culture of expert practice, intrinsic motivation, exploiting cooperation, and exploiting competition. The basic design guideline is that the learning of knowledge and skills happens in contexts that reflect the way the knowledge and skills will be useful in real life. This characteristic is made concrete by a 'company' metaphor. ComMedia is designed as a company that enables members to prepare, guide, carry out, and evaluate a wide variety of projects. As a company, ComMedia has the following mission: to offer consultation and design services to (non-)profit companies facing corporate communication media problems or companies interested in communication opportunities made possible by information and communication technology developments. These companies wish to offer a usable information and communication platform to students and teachers to set up, look after, pass through, and evaluate study projects. ComMedia is designed as a virtual learning 'knowledge company'. It is a knowledge company whose primary tasks concern knowledge about the design and use of interactive media for corporate communication purposes. It is a virtual, imaginary profit company that only exists online. Last but not least, it is a typical learning company. It's major task is to enable 'junior consultants' to become 'senior consultants'. ComMedia is a typical adhocracy. There is a strong need for innovation and creativity. There is no middle management and consultants have a lot of freedom in carrying out their tasks. We identify four major roles: administrator, senior consultants (teachers), junior consultants (students), external consultants (former students) and visitors. Tasks are carried out in (study-) projects. Each project team has a lot of freedom in completing the project, as long as they meet standard preconditions, set by teachers.

Methods

Methods refer to the ways students are supported in acquiring and integrating cognitive and metacognitive strategies for using, managing, and discovering knowledge. The basic guideline is that for each study project, students and teachers need to have the opportunities for modelling, coaching, scaffolding, fading, articulation, reflection, and exploration. The applied 'study method' is a project-based education. In our view we consider the senior consultants, the teachers, as mentors for the junior consultants, the students. Furthermore we have a balanced structure in student responsibility. For instance, students have to meet stated deadlines in the first two course projects, while they have their own freedom in setting deadlines in the last two course projects.

Sequence

The characteristic of sequence refers to the way integration and generalisation of knowledge and complex skills can be achieved. The basic guideline is one in which the study profile of a curriculum has to reflect increasing complexity, increasing diversity, and global before local skills. The study profile of Communication & Media is: C&MTheory (7 sp): a theoretical introduction in the design and use of interactive media for corporate communication. In this course the main assignment for students is to put together a so-called 'webfolio', a personal C&M information website, and to make use of each others websites to write a 'scientific' article; C&MDesign (7 sp): a practical introduction in methods, techniques and instruments for the design of media for corporate communication. Here the main assignment for students is to write a project proposal for solving a communication design problem -- for instance a website for marketing ends, and to design a simple prototype with the function of a scale-model in the building industry. C&MResearch (8 sp): a media product design research assignment where students have to carry out 'state of the art' research concerning design guidelines for, for instance, 'the corporate image on the web' or 'marketing websites that sell'. C&MProblem-solving (20 sp): a final assignment where students must solve a communication design problem in a real life context. Students must design a prototype as a 'proof of concept' and write a thesis about their work. One sp stands for one-week study, so the whole specialisation concerns 42-study weeks full time study.

Some final remarks

The design framework of Collins, Brown, & Newman although described in 1986 is still very useful for designing online study environments. We consider ComMedia as a useful proof of concept. It is successfully applied in the study program of Communication and Media. Our main experience is that students appreciate our educational approach. The students evaluations are very positive, as they stated 'we really work hard for the first time in our study'. ComMedia as an environment is only a tool. The 'socio' approach or the organisational infrastructure is in our view crucial. Based on experiences, we are further working on the design of ComMedia. Our aim is the development of a generic online platform for situated learning, which is applicable as a university expertise center for interested persons from educational and non-educational organisations. Our ultimate goal is a knowledge community for life long learning. There is much work to be done.

Discussion

We believe that the cognitive apprenticeship approach is still one of the foundations of education. Trends in life long learning and the upcoming information society only strengthens our belief. The Internet provides us with the means of designing attractive and powerful situated learning environments. We think that our design approach offers practical concepts and guidelines for designing such environments.

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Implementing a Constructivist Approach to Web Navigation support.

Romain Zeiliger
CNRS-GATE
93 ch. des Mouilles
69130 Ecully, FRANCE
zeiliger@irpeacs.fr

Claire Belisle
LIRE-CNRS
14 avenue Berthelot
69363 Lyon Cedex 07, FRANCE
claire.belisle@mrash.fr

Teresa Cerratto
UFR7, Université Paris 8
93526 Saint-Denis Cedex 02, FRANCE
cerratto@gate.cnrs.fr

Abstract: Navigating the Web has its difficulties. If some of the user disorientation originates in the practical operations for navigation and is reduced when the browser provides a map of the visited space, we argue that the main difficulty arises with characterizing Web contents. We propose a new approach to Web navigation support coined "constructive navigation support". We present the main features of NESTOR, a browser implementing this approach and we discuss the results we obtained during a first experiment in the educational domain.

1 Introduction.

In today's information society, information gathering and use constitute a major activity. The two main information access modes, query and navigation, correspond more or less to the extent to which the researched information spaces are « moderated » i.e. « the extent to which the space structures have been coordinated and controlled » (Jul & Furnas 97). Query is the access mode appropriate for moderated data bases, having a known structure: query software can incorporate features which are based on this assumed structure. Navigation is more appropriate for accessing low-moderated information spaces which don't result from a unified design process - such as the Web. Browsers, which implement the navigation mode, can hardly assume that the diverse documents they link to, have a given structure on which the design of navigation aids can be based (except the node and link structure which is inherent to hypermedia). However, some attempts have been made (Pirolli et al. 96) . On the Web, even though it is not a moderated space, query is used jointly with navigation : the space is so huge that information gathering cannot but begin with querying. However, this cannot be as successfull as it is -sometimes - with databases. The search is then pursued through navigation. It has been assumed much too prematurely that the two modes navigation and query, would add up, and, with the use of search engines on the web, provide a convivial and at the same time efficient way of finding the information sought. But information can be very hard to locate and sometimes not even found at all, although it can be there, in the very documents that are being screened. Almost all the media that have been used until now have a content which is strongly structured and controlled: think of newspapers, TV, libraries. While there are large subspaces on the Web which are in fact moderated (electronic libraries, on line news, institutions official websites), there are also numerous websites which are maintained by individuals outside of standard, official or academic information structures. And this is new: individuals have produced documents for years, but never till now have they be able to reach so quickly a large public. This might account greatly for the success of the Web, but it clearly put the cognitive load of information filtering on the user shoulders, while this load was previously mainly assumed by people acting as moderators.

At least two aspects of electronic navigation lead to navigation difficulties : at the practical level , navigating is circulating with a vehicle : a matter of locomotion (Jul & Furnas 97). Maglio and Matlock (Maglio & Matlock 98) found that "people naturally think of the web as a kind of physical space in which . At a more conceptual level, navigating is mainly a matter of decision making : selecting links to follow. Overall, it seems that the model of Navigation In-Real-Life is still valid : "orienting in the environment, choosing a route, monitoring the route and assessing that the destination has been reached" (Hook et al. 98) – except that in information gathering tasks, the destination is not a location but rather a goal. In fact, this happens too In-Real-Life as people move in a vehicle to achieve a goal. And as In-Real-Life, the two levels of activity - practical and conceptual - lead to different problems and call for appropriate support.

Users disorientation in closed hypermedia corpus (i.e. moderated information space) has been known for sometime now. Several Webmap-based new browsers are under construction (see for example http://www.cybergeography.org/atlas/web sites.html). After all, graphical user interface (GUI) and Hypertext User Interface are to date the major human-computer interaction modes that prevail on the Desktop and on the Internet and there is no reason why they should not be combined. Like others (Ashmore 97), we observed that providing a map of the visited information subspace can "ease inadequacies in Web navigation" (Cockburn & Jones 97). Still, we observed that navigating with a map-enhanced browser in the non-moderated Web brings about much disorientation. User difficulties in making navigational decisions seem to appear at a more conceptual level : identifying documents, delineating pertinent materials, organising the information into categories, pro-actively selecting links through contextual navigational cues - referred as "residue/scent" by (Jul & Furnas 97).

Just as it happens in the world of cinema, orientation deals with expectations about the "off-screen space" i.e. that space which is not visible on the screen, but which is still part of the scene (Persson 98). As noted by Harper (Harper 98) : "Interpreting information is not only a matter of what happens during reading : it is an activity that occurs within a broader institutional practice ... an academic journal for example does not just convey information: its meaning is wrapped up in such things as what is known about the status of the journal". Knowledge of such things provides the context for reading. Reading Web documents requires that users develop a specific system of interpretation through which they build the off-screen context. Because the contexts of production of the Web documents are so diverse, there cannot be easy expectations. There exists many cues about the off-screen context which can be collected along the navigation process in order to ease the interpretation task. But it remains that reading Web documents and thus navigating across them relies - more than in the case of other media – on a *personal construction* of what is meaningful.

We propose then that a software tool with the aim to support navigation should be a *constructivist environment* i.e. an environment which provides means for manipulating and working with self experience. Constructivism implies that knowledge stems from a process of interactive restructuring and transformation of personal experience. This implies - in the domain of electronic navigation - that the tools provided allow for gathering, representing, structuring and creating navigational objects - "externalizing" in the wording of Vygotsky. In this way, in constantly re-structuring the dynamic graphical representation of the browsing activity, users construct mental knowledge spaces (Zeiliger et al. 97). Structuring self experience with information requires conceptual skills as well as external "cognitive" tools (Norman).

This point is even more valid in the educational domain : indeed learners are used to access info spaces (such as libraries) which are not only strongly moderated but whose categories are also close to school categories. It is likely that when learners explore the Web they have to face a new problem : it conveys categories which conflict with the school categories (because Web categories are linked to the diverse *intentions* of the information providers). These were the types of problems that we focused on during studies - part of which are reported here - that were conducted the educational domain with a specific navigator named NESTOR. We implemented this new Web browser to test the constructivist approach to Web navigation support.

2 Implementing the Approach: the NESTOR Browser.

NESTOR is a Web client which runs on Microsoft Windows 95/98/NT platforms. It is a standalone Web browser, however the basic browsing and HTML editing features are provided through Microsoft's Active X components (TwebBrowser and THTMLEd) which means that NESTOR takes advantage of InternetExplorer 4.01 retrieval motor, options, popup menus, dynamic HTML and so on. NESTOR browsing interface is very similar to that of IE4 – except perhaps that it has been skimmed a bit ! The NESTOR left-window interface - which is specific - deals with the construction of maps and of a personal information space. In that view, NESTOR implementation can be considered as constituting an add-on to standard Internet browsers.

The main screen of NESTOR is divided into two windows : a standard browsing window (to the right) and a map window (to the left). While both windows support a range of navigational activities, the map window has been designed to facilitate information-structuring activities. Direct manipulation prevails in the map window while hypertext navigation is the standard mode in the browsing-window. Graphical user interface (GUI) in general and direct manipulation in particular are interaction modes which are more adequate for constructive tasks : tasks which require re-arranging collections of objects. The map window can be thought of -at first- as a dynamic map representing the visited Web subspace. Most navigation operations (such as backtracking) are available in both windows and provide a crossed feedback. NESTOR also records the raw navigation history and allows for re-constructing a map from a selection of this history. As "re-visit" accounts generally for more than 50% of users' operations, the map and history features (and their combinations) are very useful. There is a special mapping of search motors (representing queries in order to facilitate the exploration of the filtered documents) and some handy features which facilitate directed searching like a "breadth-first" mechanism (Newfield et al. 98). Further more, NESTOR has been designed to promote the *construction* of a personalized Web space. For that purpose, the map-window is interactive : it allows for re-arranging as well as *creating* new objects : documents, links, annotations, sub-maps, tours, search keywords and conceptual areas. It is best viewed as a sort of note-taking tool which is consistent with the Web structure : notes take the form of a personalized web which is inter-weaved with the public WWW.

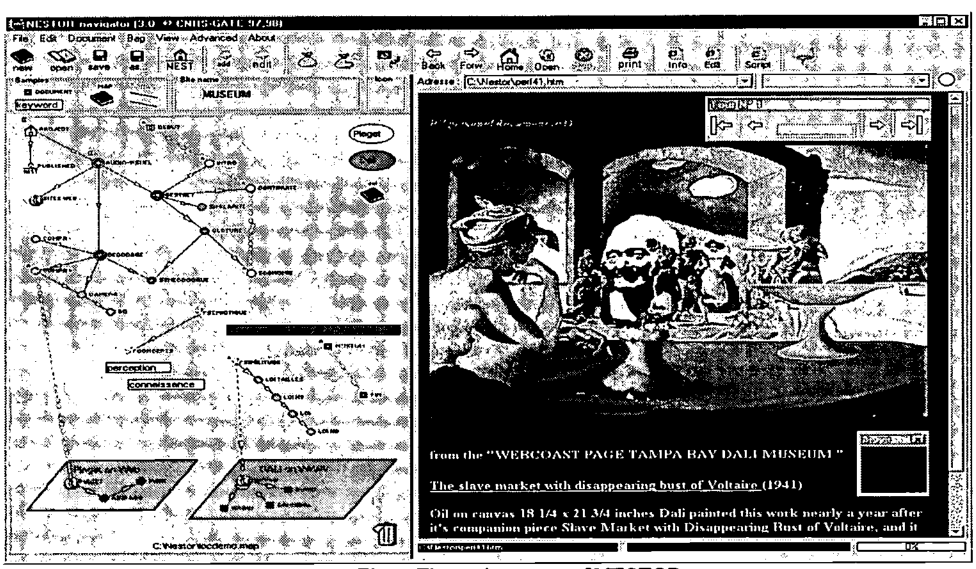

Fig 1. The main screen of NESTOR.

We now list the main features of NESTOR with more details and outline how they implement the constructive navigation approach.

2.1 Representing Self Navigational Experience : while the user performs navigational operations with the Web browser, NESTOR automatically draws a graphical representation of the Web subspace which has been visited. Every visited document is represented as a circle whose size depends on the number of outgoing links. Visited links are represented as arrows. There is an automatic layout which favours the point of view of the user's self experience (as opposed to an overview map based on a network centred representation) : as long as the user traverses to a new document, objects and arrows are posited along a straight line figuring a "user's route"; the object corresponding to the currently displayed document is highlighted providing situational cues for the user's position in the visited subspace; when the user navigates using the back or forward buttons the corresponding objects are highlighted; when the user starts browsing again, a new straight "route" is drawn. This graphical representation is dynamic and interactive : users can re-arrange the layout through direct manipulation; any visited document can be accessed directly by double-clicking on the corresponding graphical object. The use of such maps increases the visual feedback in *practical* navigation operations and facilitate orientation.

2.2 Constructing a Personal Web space: at the beginning the map reflects the visited subspace, i.e. public documents and their public links. But then, users can create personal documents and personal links, and inter-weave them with the public network. Personal links are created through direct manipulation on the map: i.e. simply drawing an arrow between to objects on the screen - either public or personal - creates an hypertext link. Personal links are represented as dotted arrows while public links appear as solid arrows. Public documents need not be aware they are linked. Personal links appear as hotwords in a separate window jointly with the document they are attached to but their anchor is not incorporated to the document itself. Building thematic maps and creating personal hypertext are activities that promote directed Web searching.

2.3 Note-taking : The process of inter-weaving the public and the personal network can be thought of as a sort of note-taking mode which is consistent with the hypermedia structure of the Web: i.e. notes include not only text but links as well, so that the Web network is annotated with a network of notes. Additional features are available in that line: annotations can be attached to every visited document be it public or personal. Annotation content is HTML-formatted so that it can include text, links or even questions in a "CAL fashion" as well. Whenever an annotated document is re-visited, the corresponding annotation is displayed jointly in a separate window. A visible clipboard - "the bag"- is also available to allow selecting and gathering of information along the navigation process; when pasting information into the bag, NESTOR includes a return link to the source document. The information gathering and note-taking activities help user structure their thoughts and construct meaningful information.

2.4 Creating Keywords Objects and Conceptual Areas: keywords, conceptual areas and sub-guides can be inserted in maps. User created keywords are automatically searched for in the visited document's text and highlighted when found (both on the map and in the document): this is especially useful when navigating across a set of documents which have been selected by a search engine. Keywords object are also extracted from the search motors queries. Web maps and keywords appear in the same window so as to allow different combined layouts. Conceptual areas help structuring the maps with object clusters.

2.5 Creating and Saving Navigational Objects : all objects created by users (maps, keywords, conceptual areas, annotations and routes) can be saved to a file and retrieved. Those objects are considered as "navigational objects" in the view that they can serve to initiate new navigational operations: for example navigating from the links in the annotations. "Conceptual orientation" is facilitated through creating, arranging and capitalizing on such objects (using their navigational properties and methods). We use the term "map" to refer to such collections of navigational objects.

2.6 Sharing Maps : NESTOR allows navigational objects to be published and shared by a group of people. Simple URLs as well as whole maps can be published. NESTOR users are warned whenever they navigates to a URL which has been previously published by one of their colleagues. In that case, annotations attached to the document (by the publisher) are available, as well as the map in the context of which the publisher has accessed the document. Bags can be published too. Computer mediated communications and collaborative navigation can help users construct meaningful information : a process Harper describes as "collaboratively defining institutional matters of relevance" or in short a "world-known-in-common" (Harper 98).

3 Evaluating the Tool and the Approach.

3.1 Educational context. We chose to evaluate the use of NESTOR in a real life setting (i.e. in the school computer room, in cooperation with the school teachers) with students knowledgeable in the use of computers and already familiar with WEB navigation. Groups of high school students (aged 15-16 years old), having prior experience with the Netscape navigator, were given a pedagogical task which consisted in finding information on the Web in order to answer questions relating to economy (Task 1) and to ecology (Task 2). They had for each task a maximum of two hours. The task was completed when they had found the relevant information and written or recorded it in the "bag" file. Task 1 dealt with a *curriculum topic* in economy: the students were each given a paper document presenting the task, with 2 questions to be answered, and a list of Web URLs where the required information could be found. The students were also each given detailed written instructions on how to connect to the main academic server where the Web addresses were already available. The students worked in dyads with NESTOR, one computer for two students. Task 2 had to do with *a topic loosely related to the curriculum*: ecology. The procedure was the following: the students worked individually (5 min.) and then in a group session (25 min.) with the aim of setting up a list of their own keywords on pollution of air and water. In this way the topic was addressed not only with an academic label but by a thematic envelope as well (the list of chosen keywords). The students were then shown and explained NESTOR keyword features and given three written questions to answer. They had 2 hours for their work and were finished when they had found and annotated 5 relevant URLs.

Having already experimented that visualizing of self navigational experience facilitates users' practical orientation (Zeiliger et al. 97) we were here interested in understanding why a user does so many revisits (more than 50% in our observations) of the same sites, even when a map is available. The first task was framed in order to provide information on this recurrent problem. The question content was labeled in such a way so as not to reproduce the exact labeling to be found on the sites indicated. This refers to the hypothesis that searching for information in low-moderated information spaces such as the Web requires greater categorization competency on the part of the user. We wanted to explore how students would succeed in matching a curriculum question with Web information. The second task was more open. We hypothesized that students have difficulties because they do not recognize the information they are seeking when the information is displayed and contextualised in categories different from the "school" categories. We therefore wanted them to use their own categories. This was achieved by having them prepare their keyword list.

3.2 Evaluation results. We discuss here information gathered on the use of NESTOR by three groups of students (two groups of eight and one group of ten). After eliminating repetitive operations due to retrieval delay (still a frequent source of disorientation in academic use), we ended up with 1061 operations within a period of 1033 minutes (17 hours and 22 min). We are concerned here strictly with the navigation operations, which were recorded on each computer.

		Task 1	Task 2	
Total operations				1061
Navigating by use of hotwords	HOTW	49 %	48 %	49 %
Navigating by use of map objects	MAP	21.5 %	19.5 %	20 %
Using BACK button	BACK	18 %	5 %	14 %
Using NEXT buttton	NEXT	1 %	1 %	1 %
Typing an URL and pressing OPEN	OPEN	1 %	1 %	1 %
Going back home	HOME	1 %	7 %	3.5%
Miscellaneous				11.5 %
Revisiting		53%	55%	54%

As expected, the percentage of re-visits is very high. Use of the map is high (about 20%, to be compared with the low use of BACK around 14%). Because NESTOR map represents only the visited subspace and because – unlike BACK – it provides a direct access to any visited document, we can assume that students were aware of re-visiting URLs in at least 20% cases . We have here situations where students revisited the same documents several times, looking for information that they were not finding, although they knew that it was there. During interviews conducted after the sessions, students spoke of their disorientation caused by the way the information was presented in the Web documents. When analysing the individual traces, we find that much revisiting also involves going along already traveled paths (among which we observed numerous to-and-fro cycles). We think we can frame this in terms of *conceptual disorientation*, not to be confused with the *practical disorientation* which has been reported when users navigate in closed hypermedia corpus using map-free browsers. More experiments are underway on a larger scale : 72 university students at Ecole de Management de Lyon (http://www.em-lyon.fr) have been given NESTOR to complete a 3 month information-gathering task on the Web and collaborative navigation features are being evaluated within the framework of the LEARN-NETT European project (http://tecfa.unige.ch/proj/learnett).

4 Conclusion and Future Work.

We found that navigating the Web even with a map-enhanced browser causes much disorientation problems. We hypothesized that much of this disorientation arises at a conceptual level, because in non-moderated information space the context for reading is often lacking. In the educational domain, when the researched information is presented in a context different from their academic context or yields novel perceptive and lexical data, learners cannot attain its meaning through surface scanning. To grasp the meaning behind the linguistic units, they have to go to the level where lies the information necessary for semantic categorizing. NESTOR maps and their navigational objects provide basic means for gathering cues along the navigation paths and structuring them with the aim of building a context for deep reading. In this perspective, future Web browsers should not only provide maps, they must tend toward full environments engaging users looking for "information that counts" into more constructive activities. Quite the contrary to surfing.

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Annotating the World-Wide Web

Sarah M. Luebke, Hilary A. Mason, and Samuel A. Rebelsky
Department of Mathematics and Computer Science
Grinnell College
Grinnell, Iowa 50112
{luebke,masonh}@ac.grin.edu, rebelsky@grinnell.edu

Abstract: The World-Wide Web has the potential to significantly change the ways in which students interact with texts, making them more active participants in their reading. Unfortunately, while many see the Web as promoting interaction, most pages provide relatively passive modes of interaction, only permitting students to click on one of a series of links to select what to read next. In this paper, we present one step toward making pages more interactive: a system that permits students to *annotate* arbitrary Web pages with notes, glosses, questions and comments; to *share* those annotations with their colleagues; and to develop *discussions* through those annotations.

1. Introduction

The World-Wide Web (Berners-Lee et al. 1994). is revolutionizing the ways in which we share information. In particular, it is affecting the ways in which we teach and learn. Unfortunately, while the Web is often seen as making students more active learners, most students can only interact with pages passively, by reading and clicking links. Some educators suggest that this is no more active than flipping pages or looking through the table of contents or index in a book.

In fact, paper provides many opportunities for active interaction with the material being studied. On paper, students freely mark the pages in their texts, underlining words or phrases, jotting notes in the margins, summarizing key sections, and even folding down corners to remind themselves of particularly important points (see, e.g., (Marshall 1998)). While some of these aspects are included as core Web technologies (e.g., the lists of bookmarks provided by most browsers are similar to the folded corners of printed texts, and perhaps more usable), others are less available (e.g., it is difficulty to jot notes electronically and keep them on an existing page).

In this paper, we describe a system we have developed to support *annotations* to pages on the World-Wide Web (WWW) Our system permits learners to add comments, notes, and glosses to existing Web pages, thereby helping students become more active learners. While our system does not provide all of the mechanisms suggested in (Marshall 1998) (e.g., we do not support highlighting), our system provides an appropriate starting point for developing richer systems.

We have developed a system that permits selected *annotation* of arbitrary Web pages. Our system permits students to annotate pages with public and private notes, glosses, questions, answers, and discussions. We expect that as students have increased ability to interact with Web pages, they will become more active learners.

There are other annotation tools (or Web-based systems that include annotations) available, such as ComMentor (Röscheisen 1995), CoNote (Davis 1996), the Group Annotation Transducer (GrAnT) (Schickler et al. 1996), HyperWave (Maurer 1996), Medium (Lapique and Regev 1998), and WebCT (Goldberg 1998). We distinguish our system from by supporting annotations of both local and remote pages; permitting annotations at author-defined and automatically-generated positions on the page; supporting annotations on changing pages; and providing multiple protection levels for annotations.

We developed this annotation system to serve multiple purposes. First, an annotation system would provide a way for a student to take personal notes. Given the increasing number of course pages available, and the increased use of computers in the classroom, it may be possible for students to take online notes on course pages during class. For example, (Rebelsky 1998) reports that in a computer-equipped classroom in which daily course outlines were available online during class, some students opened the daily outline in an HTML editor to add their own notes. Second, an annotation system is also an appropriate way to share notes. For example, one might post questions about an assignment or suggest followup readings. Third, students can use sequences of notes to provide a discussion (similar to a typical threaded bulletin-board, but with focus on a particular point on a Web page).

For an annotation system to be successful, it must not only accommodate the needs, preferences, and habits of its users, but also predict and shape them. A student or instructor new to hypermedia authoring and usage may understand the ability to add notes to a page, but may not think about other issues, such as *protection* (who should be able to see an annotation), selection of *annotation points* (where annotations should go in a document), or *appearance* and *positioning* of annotations. We report on these design issues and the user testing that guided our design choices in the subsequent sections.

2. Architecture

Among our primary goals was to design an annotation system that could be installed and used widely. This led to a number of core requirements, including

- a teacher should be able to install and use the annotation system without making modifications to the Web page server;
- students and teachers should be able to use the annotation system with current Web clients; and
- students should be able to annotated a wide variety of pages, including pages on different servers and pages that neither teachers nor students had direct control over.

These requirements led to an architecture based on a centralized annotator and an extended version of the core of Project Clio (Becker and McLaughlin 1998) (Becker et al. 1999). A single CGI script is used to coordinate all annotation activities. A page request is routed through the CGI script. The CGI script

1. retrieves the page from a server (or from the file system, if the page is stored locally to the CGI script),
2. adds *annotation points* (described in section 2.2),
3. identifies the annotator (including group permissions),
4. fetches annotations from an annotation server,
5. inserts the annotations or links to the annotations into the page,
6. updates the links on the page so that the CGI script is used for further page fetches, and
7. returns the modified page.

In a future version, we expect to be able to use a form of proxy server for the same purpose.

The retrieval of original page, identification, link update, and return are handled by Project Clio. The addition of annotation points, fetching of annotations, and insertion of annotations were added for this project.

Because the annotation system is based on a CGI script, it is relatively easy to install (some servers may need a flag set to permit use of CGI scripts). Since it does not require modification to the underlying pages, it permits annotation of pages that neither teachers nor students control. Since the determination and fetching of annotations is done at the server side, and not the client side, it requires no extensions to clients. However, the current mechanism for displaying annotations does require JavaScript, which is supported by both of the most popular browsers (Netscape Communicator 4.0 and Internet Explorer 4.0). The display mechanism is described in section 3.

A settings file can be used to customize some aspects of the CGI script. In particular, it can be set to accept requests from only certain domains or certain accounts. This permits instructors to limit access to annotations. (The protection system described in section 2.1 provides additional forms of access control.) The settings file can also influence which pages can and cannot be annotated. For example, some instructors might wish to limit annotations to their own pages, or to a particular set of pages they have already identified.

2.1. Protection

There are three trends for protection of annotations: annotations are either private (accessible only to the user), group/semi-private (restricted to a group of users), or public (accessible to anyone reading the page). Many systems permit only one type of annotation. For example, CoNote provides only group annotations. Similarly, systems treat the different types of annotations quite differently. For example, WebCT (Goldberg 1998) separates annotations, which are private, from discussions, which are semi-private, using different interfaces for the two.

We chose to provide all three "types" of annotations with a consistent interface. When a user creates a new annotation, (s)he may choose to make it private, group, or public. Because we could foresee different groups of people using the same page (e.g., faculty, teaching assistants, and students might all have discussions on a course page), group protection also includes a note as to which groups may view the annotation. When browsing annotations, readers can see the headers of all the annotations, but may only view the bodies of annotations for which they have appropriate permissions.

2.2. Annotation Points

An annotation system for the Web must accommodate the differences between the Web and paper. One particularly important difference is that while paper remains fixed (and any errata are separate documents), Web pages often change. This means that annotations cannot be conveniently tied to a particular piece of text. Where should annotations appear?

Some annotation systems, such as the original NCSA Mosaic annotations (NCSA 1997), place annotations at the page level, with one annotation per page. Such placement seems overly course given the more typically fine-grained annotations students typically make. Discussions with faculty and students suggested that there is need for more specific placement of annotations. For example, a question about a particular problem in a homework assignment best belongs near that problem. More importantly, an instructor interested in having students gloss a work (i.e., add commentary) will not be satisfied with annotations that are so coarse-grained.

A finer-grained ideal would be to permit users to select the text to be annotated. Such a solution is used in the Multivalent Document system's markup system (Phelps and Wilensky 1997). Unfortunately, standard HTML browsers will not easily support this choice. One alternative, used in the Group Annotation Transducer (Schickler et al. 1996), is to allow users to specify the text that will be tagged. Unfortunately, entering the appropriate text requires more effort on the part of the user and also suggests difficulties if the page changes or if the same phrase appears multiple times. Both of these fine-grained solutions may lead to annotations at awkward, confusing, or otherwise inappropriate points on the page.

Another alternative is to allow authors to specify the annotation points in a document, as in CoNote (Davis 1996). The disadvantages of such an alternative is that it places all the burden on the author, and provides little freedom for the annotator. An advantage is that it permits annotations to remain through changes of the document (something particularly difficult in phrase-based annotations).

We chose a hybrid solution, in which annotation points can be added by the author, but are also generated by the system for "natural" points in the document. At present, these points are currently set to be section headings, which often designate a logical break from one thought to another. For typical documents, section headings are fine-grained enough to permit annotation at a reasonable level but coarse-grained enough that the document is not over-croweded with annotation points. We use heuristics based on approximate text matching to determine the (re-)placement of annotation points in changed documents.

3. The User Interface

A similarly interesting problem was where to put the annotations themselves. A number of alternatives suggested themselves (many of which have been used in other systems). One might make links to the annotations and bring them up in the same window when clicked. Such a solution is easy to develop, but makes it more difficult for the novice Web user to view both text and annotations. One might make links to the annotations and bring them up in the same window. One might insert the annotation text into the same page. However, this can make the original text more difficult to read, as the annotation interrupts the flow of the text. One might use popup windows, in which the annotation appears over the annotated text when one moves the mouse over that text or clicks on it.

3.1. Surveying Potential Users

We decided that this was not an issue we could approach in the abstract, after the system was constructed. Hence, we surveyed potential users about the strengths and weaknesses of a variety of designs. We developed eight different prototype interfaces for an annotation system and surveyed students with a variety of computer background. The examples varied in appearance and technical design issues. One example displayed annotations in a separate pop-up window. Another brought the user to a new page which displayed the annotation and the corresponding paragraph (the annotated text). In a third design, the annotations were visible on the page, within the document. For another the annotations were in the margin. The colors and icons changed from example to example, while the text and annotations were constant. Since we worried about interrupting the flow of text, a few examples permitted the users to turn the annotation feature on or off. We did not test the interface for entering the system (in which students enter their account and password) which is taken from Project Clio (Becker and McLaughlin 1998) (Becker et al. 1999).

Most participants preferred a pop-up window to view and add annotations, since they did not want to disrupt the page they were on. Annotations directly on the Web page seemed to add clutter and make the page less readable. Also, the less obtrusive the annotation buttons were, the better. At the same time, many found the ability to hidc and show the annotation buttons (or the annotations themselves) confusing.

Based on this feedback, we developed a hybrid of the eight used in the survey. We chose to use two small buttons to indicate the annotation points. One button is used to add annotations and appears at every annotation point in the document. The second button is used to indicate the presence of annotations at that particular point in the document, and is only used if there are annotations for that annotation point.

3.2. Interacting with the system

If one clicks on the **View Annotations** button, a separate window appears showing a collapsible tree of annotations corresponding to that annotation point. There is a tree of annotations because we permit readers to write followups to other annotations, and found a tree the most natural way to represent the many discussions that may come from one annotation point.

If there is only one annotation available for a particular annotation point, that annotation is used as the "alt text" for the annotation button. In modern browsers, such as Netscape Navigator 4.0, this provides a quick pop-up view of the annotation. If multiple annotations are available for a particular annotation point, the number of annotations is used as the "alt text".

When the user selects the **Add Annotation** button or the **Followup** button, a new window appears. The annotator can enter a name, title, and the annotation. Annotators can also select permissions: self, selected groups, everyone on system, world. Finally, an annotator can choose to make an annotation anonymous (so that, for example, students can post comments without fear of appearing less confident or successful they wish to appear).

While the annotations do not preserve text formatting (e.g., whitespace), they can be written in HTML, the HyperText Markup Language (Raggett et al. 1998). This gives authors freedom to format their comment or question by adding emphasis, tables, lists, and other structure.

3.3. Followup Surveys

After the new interface was complete and the underlying system implemented (so that subjects could add their own annotations and not just view existing annotations), a second group of subjects was brought in to test the new interface. This group of subjects included some of the first group, but also some new subjects.

While participants were generally satisfied with the structure of the implemented annotation system (e.g., the pop-up windows), many identified some technical problems that would not be obvious in a prototype. For example, many pointed out that the windows should auto-reload, so they can see the changes they made immediately. It was also noted that a close button was needed in the annotation window. Finally, many subjects needed more ready access to a help system.

4. Future Work

We have developed and begun testing of a system that we expect will enhance the effectiveness of course pages by permitting students to add notes and questions to Web pages in and out of the classroom. Our initial user-testing suggests that this will be a usable system, but we do not yet know how much or how it will be used. Because the system depends on parts of Project Clio, we must wait until Fall 1999 for our initial course trials. Based on feedback from those trials, we expect to make extensions and modifications to the system.

We also expect to refine the interface for the "annotation tree" (the set of annotations for a particular point in the document). While we conducted regular testing of the placing and appearance of annotations relative to the page, we were able to do less testing of the appearance of this tree.

Finally, we intend to provide alternate "views" of the annotations so that, for example, a student who wishes to print a document with annotations may conveniently do so. We expect to test at least two alternates for this "all in one" view: one in which the annotations are placed near the text they annotate and one in which they are used as footnotes (with footnote numbers places in the text).

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USING A THEORETICAL MULTIMEDIA TAXONOMY FRAMEWORK

Rachelle S. Heller
The George Washington University
Washington DC, USA
Sheller@seas.gwu.edu

C. Dianne Martin
The George Washington University
Washington DC, USA
Diannem@seas.gwu.edu

Abstract: An expanded multimedia taxonomy is proposed to provide a framework for understanding and conceptualizing interactive multimedia for the purposes of teaching, research and project design. The taxonomy is an especially helpful tool for the generation of evaluation materials. Specific examples of how to generate evaluation categories and concerns is included.

WHAT IS MULTIMEDIA?

Multimedia is a polysemous term - a term with many definitions and in this case many roots. In this paper, multimedia is defined as the seamless integration of two or more medium. A multimedia taxonomy is proposed to help organize the discipline based on a previous media taxonomy (Heller & Martin, 1995). The taxonomy helps to classify the space called multimedia and helps to draw attention to difficult issues. Whilc multimedia is an emerging field, the fact that we can provide a taxonomy indicates that it has reached some level of stability and maturity to be reckoned with.

THE TAXONOMY

The multimedia taxonomy can be visualized as a three dimensional matrix (Heller and Martin, 1998). Media type, the rows of the matrix, pertains to the various media involved: text, sound, images, motion and combinations. Media expression, the columns, refers to the level of abstraction portrayed using these media: elaboration, representative and abstraction. Context, the third dimension, portrays the various roots in multimedia: disciplines, interactivity, audience, aesthetics, quality and usefulness. As originally expressed the taxonomy had 90 cells in three dimensions to be defined (Heller and Martin, 1995). In the beginning work, it was observed that evaluation or design questions often repeated themselves, regardless of the medium form or expression format. For example, questions about text size are appropriate no matter the format of textual presentation. Based on this observation, the taxonomy was expanded to provide a category in the format called general - this category is used for questions that are constant over the format space. Hence there are 120 cells provided by the taxonomy and each can be expressed as a series of questions that can be used as a development or evaluation guide. The newly expanded taxonomy becomes a floor, not a ceiling, for a series of guidelines that can be used to generate a series of questions about an application.

Media type is arranged as a series of individual medium of increasing complexities (i.e. storage). The various media should be clear. Text is the presentation of information using an alphabetical symbol system. This includes prose is various languages as well as presentations in such forms as mathematics or other symbol systems. Sound is the inclusion of spoken word as well as generated tones forming music or other audible information. Images include photos and hand drawn items while motion can be motion pictures or animations. Multimedia, as defined above, is the inclusion of any two or more of these.

Media Form	General	Media Expression Elaboration	Representation	Abstraction
Text	Math functions were correct Is it clear which input device to use Word choice was unclear/clear Grammar was correct Reading characters on screen (very hard to very easy) Spelling was correct (No to Yes)		Font for bold and italics is readable	
Sound	Sound quality (unclear to clear) Sound speed (too fast/slow..just right) Sound volume (too loud/soft..just right)	Speech is Captured without stutters	Sound effects are recognizable	
Graphics	Quality of image (low to high) Size of image (too large/small to just right)			Icons are clear Iconic Metaphor is sharp
Motion	Quality of motion (jerky to smooth)			
Multi media	Media Integration (Uncoordinated to coordinated) Media technical synchronization			

FIGURE 1: Sample Questions from the Quality Dimension

Contextual categories that are not applicable to the specific product being evaluated can be eliminated from the protocol. The questions (Figure 1) are framed either as a Likert scale question with five gradations or an open ended questions requiring a free form user response. Those that are intended to be considered using a Likert scale are presented with the categorical extremes listed in parenthesis. For example, to evaluate the item listed as use of motion one can generate a question for the form:

	Jerky				Smooth
Use of motion	1................	2...............	3...............	4..............	5

The Multimedia Taxonomy is best understood in its application. The new media space is 6x4x5, where each cell can be used to address specific aspects of media design or evaluation. For example, the aesthetics category might encompass the following concerns: In the general expression of text, we might ask, is the font size appealing, while in the elaboration expression of text, it is appropriate to ask the aesthetic question concerning the richness of the literary expression on the continuum from dry to poetic. In representational expression of text, we might ask whether the format of the outline is logically well-structured and in considering the abstract expression of text within the aesthetic categories, we could ask if the textual image as an icon is pleasing.

Similarly, when considering questions of audience in the general category for text we might ask if the instructions are clear, while in elaborative or representational expressions of text we might ask evaluative questions about whether the feedback to the audience is appropriate or if there is a compatibility between the reading level of the audience and the level of expression of the textual description. The usefulness category prompts us to assess the value added by a medium type or expression. The extended Multimedia Taxonomy elicits questions about sound quality as well as sound impact.

Under the category of Usefulness, the evaluation protocols contained questions about whether a medium like sound was functional, by asking users to rate the sound on a Likert scale that ranged from annoying to helpful. The protocols also contained open-ended questions about what the user remembered about the sound in the application being evaluated. Thus, the newly expanded Multimedia Taxonomy becomes a floor, not a ceiling, for a series of guidelines that can be used to generate evaluation questions about a multimedia application. Parts of the taxonomy not relevant to the specific product being evaluated can be ignored when developing the evaluation protocol and data-gathering instruments.

AESTHETIC

The guidelines in this section are intended to examine the appearance, artistic look or impression of the IMM. Questions related to design, rather than function, are the focus in this section Figure 2 is an example of questions for aesthetics.

AUDIENCE

Audience guidelines are intended to direct the evaluator to address issues of how the IMM relates to the audience and how the audience members might be able to process the medium form in a specific medium format. For example in the area of text as elaboration, it is necessary to ask whether the text is at the reading level for the intended audience. On the other hand, while text as representation does require the user to read, there tend to be fewer words and grammatical constructions in this category but the representation (e.g. outline) might not be familiar to the particular audience. This section requires the evaluator to know to whom the IMM is intended. Before preparing an evaluation protocol for a particular IMM, the evaluator should know who the intended audience is.

DISCIPLINE

Guidelines in this section are intended to identify the content specific material in each of the media forms within a specific medium format. For example in reviewing text that is presented in representational form (outlines or lists) is necessary to ask here whether the lists are complete and accurate within the content area. This section is often best evaluated by experts in the content area rather than by IMM designers or members of the intended audience.

Media Type	General	Elaboration	Representation	Abstraction
Text	Font size is appealing Free from stereotypes Media overuse? Overall impression Screen design Screen spacing Use of color	Literary Expression (Dry to Poetic)	Format (i.e. outline) is well placed Position of messages (appropriate)	Metaphors are consistent within the application Text image or icon
Sound	Sound (annoying to helpful) Sound (noisy to tuneful) Volume (too soft/loud to just right) What did you think of the sound?		Background sound (pleasing)	Sound effects (not pleasing to pleasing) Sound effects (unclear to clear)
Graphics	Still images attractive? Use of color pleasing?		Background images (too faint)	Icons pleasing?
Motion		Video or animation (not pleasing to pleasing)		

Figure 2: Sample questions based on aesthetics issues

INTERACTIVITY

In this category, evaluators should be addressing aspects of control, navigation and linking. Aleem (1997) is examining the relationship between the attribute of interactivity to the media type and expression. He has further subdivided the attribute of interactivity into four categories: Passive, Reactive, Proactive and Directive. With the Passive aspect of interactivity, the user has no control, but instead, all control is embodied in the application (i.e., a PowerPoint presentation) Reactive interactivity provides limited response for the user within a scripted sequence. Proactive interactivity allows the user to play a major role in the design and construction of situations, typically by manipulating values for valuables. Multimedia that has interactivity at the Directive level allows the user both to respond to and to initiate actions within the application as well as to tailor aspects of the environment, such as selection of color choice, feedback choice, and so on.

QUALITY

This section refers to the technical, reproductive aspects of the IMM. Quality issues relate to clear images, correct synchronization and timely delivery.

USEFULNESS

This category refers to the value of the material presented in the IMM as well as the ease of use of this material. Since Interactivity covers the navigational issues and Usefulness covers the ease with which a user can operate the application there seems to be a muddy ground between the two categories. But there is a distinction. Usefulness also includes whether the user can operate the equipment necessary to make the application run. For example, questions such as can the user operate the head tracker or the roller ball as well as is there a need for external devices to run the IMM are appropriate in the ease of use category.

As can be judged from the foregoing paragraphs, not all of the 120 cells contained within the three-dimensional Multimedia Taxonomy are completed. Some are being examined in detail, while others are still to be developed. Students in courses in the Seminar on Multimedia Evaluation in the Department of Electrical Engineering and Computer Science at The George Washington University (Heller, 1994) have been successful in designing evaluation protocols using the Multimedia Taxonomy as a guideline. Figure 3 represents a sample of the survey comments developed from the formative evaluation of Ada Mentor, an online web site for the study of the Ada programming language. The Multimedia Taxonomy helped pinpoint such problems as too many forms within the web site and the inability for a user to see the entire page. They were able to suggest on the bases of the evaluation, that the Ada Mentor developers reduce the navigational capabilities and clarify the functionality of navigational icons.

CONCLUSIONS

We believe the multimedia taxonomy is a reasonable organizing framework. Admittedly there is room for extension of the multimedia taxonomy if new ways of thinking about multimedia are presented. The extensibility of the taxonomy is demonstrated by the ability to take a cell or series of cells and, using them, form new detailed sub-taxonomies. This is demonstrated by the work presented by Aleem (1997).

The multimedia taxonomy is a solid framework - the details of each of the cells needs to be completed. Currently we are beginning usability studies using the taxonomy. Specifically, we are interested in whether evaluators can use the taxonomy as a guideline to improve the coverage of their existing evaluation protocols or does the fragmentation of the taxonomy interfere with, or distract from, the evaluation. In continuing efforts to establish quality evaluation products we are also beginning to review the use of object oriented design techniques and metaphors as a possible format for expressing multimedia evaluation. As a beginning we are considering each medium (text, sound, stills and motion) as a specific object and each object has its specific attributes (size, color, form declaration, representation and form) and behaviors (interactions). Objects can form clusters and it is these clusters that can have different relations and interdependency. Investigations into the use of cluster analysis as a methodology for multimedia evaluations is just beginning.

As an organizing principle the Multimedia Taxonomy presented here can be used to understand both design and content messages. The next step is to review the taxonomy in light of various studies in the psychological and cognitive aspects of understanding of multimedia applications to determine whether this taxonomy can shed light on these areas. Questions such as how we come to understand an image and how that understanding is different from our understanding of text can be answered in part by using the taxonomy. We have presented a few examples of the impact of the Multimedia Taxonomy on the design and implementation of evaluation protocols for multimedia products. More work in this area remains to be done. Finally, however, the Multimedia Taxonomy represents an attempt at the formalism that is needed to provide the both a theoretical and practical framework for the new and rapidly growing field of interactive multimedia.

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AdaMentor Formative Evaluation Comments for Open Questions

Keyword	Actual Comments of Concern	Actual Comments of Praise
Text	Hard to read; could be bigger Too much technical language	Not too wordy
Navigation	Hard to find exercises; Buttons didn't load in some cases Need to move inherent icons Need better button description Trouble getting back to where I was	Link design is efficient
Speed	Took forever to load Slow on T1 line Slowness more trouble than its worth	
Screen Design	Can't see entire page Screen size for exercises are too small	Clean setup Easy to look at Nice graphic layout
Interactivity	Not much better than a book Book could have been read anywhere Exercises are not interactive	
Content	Need better explanations Too much technical language Only include security information when necessary Make it more fun	Information on each topic was sufficient
Audience	Get it off the net Show Ada's practical application	Good tutorial for learning Ada First of its kind I've seen Easy to access Potential to be good tutorial

FIGURE 3: Selected Responses to Formative Evaluation Protocol Using the Taxonomy

The Design and Development of a Web Site to House National Accreditation Documentation

Caroline M. Crawford
University of Houston – Clear Lake
2700 Bay Area Boulevard, Box 50
Houston, Texas, USA, 77058-1098
crawford@cl.uh.edu

Abstract: The design and development issues surrounding a World Wide Web-based site to house documentation for a national-level accreditation of a College of Education is daunting, to say the very least. Many different facets introduced themselves through out the design and development of such a Web site. The Web site in question concerns a national accrediting body, National Council for the Accreditation of Education (NCATE), that has led a "bleeding edge" push towards the design and development of a Web site that houses pertinent documentation concerning the professional education unit that is undergoing the accreditation process. Although numerous possible future questions and concerns within the design and development process were thoroughly discussed and responses were decided upon, there were numerous occurrences throughout the design and development process that were not expected. These occurrences are the primary focus of learning and should be discussed through a much larger audience so that others working through such a process will be familiar with any concerns that may arise within their own situation.

Introduction

Accreditation has become a primary concern within the professional education units over the previous fifteen years. Although quality standards have been in place within the educational realm for well over a fifty-year period, recent events and publicity have caused the strengthening of accreditation through out the United States of America. The accreditation process is built upon clearly defined standards that each professional education unit must delineate through out the accreditation process. As stated by the National Commission on Teaching and America's Future,

> Setting Standards is like building a pyramid: Each layer depends on the strengths of the others. Students will not be able to achieve higher standards of learning unless teachers are prepared to teach in new ways and schools are prepared to support high-quality teaching. Higher standards for students must ultimately mean higher standards for teachers and schools. Otherwise, the end result of the standards movement will be more clearly documented failure rather than higher levels of overall achievement. (1996, p. 27)

Due to this stated desire to raise the standards of the educational units within the United States of America, a focus has been placed upon accrediting bodies. Interestingly, accrediting bodies at different levels through out the educational realm. From specialization areas, such as Spanish through instructional technology, through overarching accrediting bodies, such as the National Council for the Accreditation of Teacher Education (NCATE).

Herein lies an interesting element. Due to the strong feelings of necessity towards an overarching, professional education accreditation, Roames (1997) describes the national conference of 1951 wherein the efforts of at least four representative council organization bodies came together. As a result of these efforts, the National Council for the Accreditation of Teacher Education (NCATE) was approved. Although NCATE was developed almost fifty years ago, the numerous reforms that NCATE has worked through have developed a stronger, living organization that spearheads accreditation processes. Herein lies the focus of this article; NCATE developed a task force, the NCATE Task Force on Technology and Teacher Education (National Council for the Accreditation of Teacher Education, 1997) which noted the desire to "establish pilot projects with a few institutions to implement and evaluate state-of-the-art uses of technology in the current accreditation process .... These pilot projects should be conducted both by institutions seeking initial accreditation and those pursuing continuing accreditation" (National Council for Accreditation of Teacher Education, 1997, p. 19). This statement not only indicated the desire of the NCATE organization to further discuss the implementation of technological innovations within the accreditation process, but it seemed to be an open invitation to professional education units to establish pilot projects to introduce technological innovation into both the initial and continuing accreditation process.

Purpose of the Study Statement

The purpose of the study was to qualitatively describe the design and development of a professional education unit Web site to integrate the unit's applicable documentation concerning the units anticipated NCATE continuing accreditation.

Design

Instructional Design Model

The Four D Instructional Development Model (Thiagarajan, Semmel, & Semmel, 1974) was implemented as the instructional design model due to its clarity and linear nature. However, the interesting aspect of this instructional design model choice was the choice of a linear model to develop a nonlinear learning environment, which may also be described as ill-structured landscape environments (Wittgenstein, 1953). Questions were raised concerning the positive as well as detrimental effect that a linear model would have upon a nonlinear learning environment and, after numerous discussions, a clarity of thought between a linear instructional design model and a nonlinear learning environment was reached. Although a linear instructional design model may be implemented to develop a product, this linearity has no impact upon the final product due to the developmental structure versus the product structure; although a linear model is decided upon due to it's clarity of process and ease of use on the part of the designer and developer, this would not impact the product of a nonlinear learning environment.

Nonlinear Learning Environment

The nonlinear learning environment, clearly displayed through the possible use of the World Wide Web environment, is one which offered the ability to link multiple areas of pertinent professional education unit documents together within one Web site. This linking ability offered a nonlinear environment through which the NCATE Board of Examiners (BOE) members who would ultimately view the documents. This nonlinear environment would offer a clarity of though and information to the NCATE BOE members and, theoretically, ease the strain placed upon NCATE BOE members who are required to traverse this documentation over a short time period. Another positive aspect to the implementation of a nonlinear learning environment for the pertinent professional education unit documentation is the ability of the NCATE BOE members to have the option to view the pertinent documentation before ever stepping foot on the university campus. The NCATE BOE members had the ability to view relevant documents before visiting the campus that would offer more time during the visit to interview and view areas, persons, and places of interest.

Qualitative Data Collection

During the initial components of the research process, as well as through out the design and development of the professional education unit's NCATE Web site, certain aspects were clearly articulated as having relevance towards the importance of the process and, therefore, were clearly stated as areas of data collection. The researcher implemented a qualitative data collection so as to obtain necessary, relevant, and descriptive data pertaining to the design and development of the Web site. The three areas through which data was collected through out the design and developmental process were the areas of historical research, participant observation, and interview.

Historical Research

Historical research describes the location, obtainment, development, and digitization of the documentation that was integrated into the Web site. Through out each of these processes, perhaps the most difficult would be the location of the historical documentation. Although the faculty and staff within the professional education unit were clearly helpful and went beyond their duties, the difficulty in merely locating the historical documentation was a timely venture. The historical documentation was available to the Web site developer without question; however, the location of the documentation and the ability to actually "put hands upon" the documentation was another matter. Yet, as previously stated, the faculty and staff within the professional education unit were of the utmost help through out the location, obtainment, development, and digitization of the documentation process.

Participant Observation

The ability of the researcher to become an integrated member of the professional education unit was of utmost usefulness through out the design and developmental period. As an "insider" within the professional education unit, the faculty and staff were comfortable with the researcher and were willing to offer personal thoughts and beliefs concerning the design and development of the Web site, with little to no concern as to the trustworthiness of the researcher. The integration within the professional education unit was a helpful part of the design and developmental process, and offered numerous instances of thoughtful reflection and discussions with the faculty and staff of the professional education unit; without such an integrated aspect, the researcher would have most likely missed instances of clarity and breakthrough discussions pertaining to the Web site.

Interview

The Web site was continuously appraised through out the design and development periods. There were two groups of appraisers; the first group being technical and interface usage experts, with the other group being Texas members of the NCATE BOE organization. The reasoning behind the use of the NCATE BOE members from Texas was the desire to eliminate any chance that the NCATE BOE members chosen for the professional education unit's BOE visiting team could possibly have been a member of the Web site design and development research; in other words, NCATE BOE members from Texas would be ineligible to act as NCATE BOE visiting team members for the professional education unit that was designing and developing the Web site, because no BOE member may examine a university within their own state. This structure is in place to ensure any form of in-state bias would be extricated. The willingness of the Texas NCATE BOE members to act as appraisers through out the design and developmental periods is a strong indication that the collegiality and desire towards excellence within the education profession ensures the quality of our education profession's future.

Development

The development of the Web site consisted of three main elements: the developmental process, the integration of documentation, and quality assurance. Within each of these areas, the desire for appraiser feedback to aid in the developmental process was clear.

Developmental Process

The process through which the Web site development progressed was steady and streamlined. Through out regenerative periods of development, appraisal, reflection, and significant redesign, the Web site focused upon quality assurance and the integration of documentation. The appraisers offered reflective, significant input through the interview process that aided in the development of the Web site.

Integration of Documentation

The steady integration of documentation through out the developmental process offered numerous instances of nonlinear integration of documentation as well as the hyperlinking of specific subject areas within and between the documentation. The hyperlinking process between the specific subject areas within the documentation was perhaps the most time-consuming aspect of the integration process, outside of the location, obtainment and digitization of the documentation.

Quality Assurance

The quality assurance was an element that was felt through out the design and development of the Web site. Without the quality aspect as an integral part of the Web site, the researcher felt that the design and development was a useless exercise in futility. Therefore, the quality assurance was felt through the design, development, appraisal, redesign and redevelopment. Quality assurance can not be overemphasized as a primary aspect through out the design and development of the professional education unit NCATE Web site to house pertinent documentation.

Results

To address the previously stated purpose of the study, the methodology chosen was of a qualitative nature, specifically ethnography. Within the ethnographic areas, a triangulation between historical research, participant observation, and interview was implemented. A further consideration within the research was the limitations of the study, which are integral to the complete understanding and significance of the research.

Historical Research

The historical research was an integral aspect within this developmental research. The documentation offered the ability to not only integrate and delineate numerous aspects within the professional education unit, but also to develop a nonlinear hypertext environment through which the documentation would offer the ability to display further understanding of the knowledge available. Although the location, obtainment, development, integration, and digitization of the historical documentation was of primary concern through out the design and developmental periods, the careful development and thoughtful appraisals were essential to the quality assurance of the Web site.

Participant Observation

The use of participant observation through out the design and development of the Web site offered an unstructured viewpoint through which to obtain thoughtful responses and viewpoints without the strict question-answer protocol that would underlie the interview process. The ability of the researcher to act as an "insider" within the professional education unit allowed both faculty and staff the comfort zone through which to impart important comments concerning the design and development of the Web site, as well as to verbalize any concerns or questions that arose.

Interview

The interview process consisted of structured question-answer sessions that were made available through a Web-based form that would ensure the appraiser a comfortable environment to offer input, reflect, and further comment upon requested information as well as outside areas that were important to the appraiser. Instances of outside e-mails also occurred through out the appraisal process; although without any form of incentive on the part of the researcher. The appraisers seemed to require an outside, personalized mode of connection with the researcher that perhaps fulfilled a deep-seated desire to connect on a more personal note, as well as offer further insightful information to the researcher. Through such interviews, whether through the formalized question-answer Web forms or more informal e-mail communications, the quality assurance of the Web site was ensured.

Limitations of the Study

The limitations of the study were few; however, each limitation was a significance consideration through out the study. The first limitation was the appraisers might have answered the stated questions so as to please the researcher. This is a possibility whenever human subjects are used in research situations; however, a considerable effort was put forth through the deliberate working of the Web site feedback forms so as to not influence the appraisers. A second limitation as that the appraisers would interpret the stated questions differently than the intended meaning. Due to this possibility, the researcher gave each question careful consideration so as to reduce the interference of questionable grammar or verbiage. A third limitation is the danger of generalizability of the study. This study can not be generalized beyond the professional education unit for which the Web site was developed. However, certain aspects of the design and developmental process may be useful for future endeavors and are offered as a modest component towards future efforts.

Conclusions

The occurrences through out the design and developmental periods of the Web site offer numerous instances of thoughtful reflection, learning, and growth. Such experiences must be conscientiously considered so that future endeavors will gain from such experiences. Although the observations and experiences attained through this research are considerable, future endeavors will offer significant possibilities towards the establishment of further defined and delineated facets of learning.

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Human/Computer Interface Issues for a National Accreditation Web Site

Caroline M. Crawford
University of Houston – Clear Lake
2700 Bay Area Boulevard, Box 50
Houston, Texas, USA, 77058-1098
crawford@cl.uh.edu

Abstract: The use of the World Wide Web as a tool to disperse information for national accreditation has been severely underutilized. The ability to offer informational documentation concerning the health of an institution, such as a university, in a non-linear hypertext format is one which could offer a healthy, severely needed element towards the accreditation process. The ability to ease the accreditation process towards a more flowing sharing of information has been a long time coming, but one which is on the brink of exploding. The National Council for the Accreditation of Teacher Education (NCATE) is one national accrediting agency that has realized the Web's vital use and has begun the process of implementing this underutilized tool.

Introduction

The use of the World Wide Web (Web) towards the development and integration of information for a national accreditation structure is in its infancy. However, the utilization of the Web as a tool to disperse information has presented itself as a primary area of interest to one national accrediting body, the National Council for the Accreditation of Teacher Education (NCATE). NCATE is an accrediting institution that has stated their desire to pull technology into their accreditation process. NCATE developed a Technology Task Force (National Council for Accreditation of Teacher Education, 1997) that stated the desire as well as the need for the ability to integrate technology into the accreditation process. One such request was the desire of piloting the development of a Web site through which the integral documentation pertaining to the accreditation process that would be available. This would allow for the accreditation Board of Examiners (BOE) to view the documentation before stepping foot on the campus, as well as the ability to link documentation in a hypertext format within the Web site.

The importance of human/computer interface issues through out the Web site developmental process can not be underemphasized. Although the main focus of the developmental process was the placement of documentation on the Web and the interrelation of the documents within the site, the appraisers for the Web site focused upon the human/computer interface issues to a large extent. Although the appraisers were asked to comment upon structural strengths and weaknesses, the appraisers consistently focused upon the interface issues as being of primary importance. The issues, concerns, and comments concerning the human/computer interface are integral to the development of a national accreditation Web site to house pertinent documentation.

Human/Computer Interface

The World Wide Web (Web) is a medium with the capacity to display nonlinear structures in a hypertext environment, which in turn leads to a further understanding of ill-structured knowledge domains on the part of the user (Wittgenstein, 1953). These ill-structured, nonlinear, hypertext environments offer a cognitive flexibility to the documentation, therefore the knowledge, that is obtained by the user (Spiro & Jehng, 1990). Although the constructivist theoretical structure embraces such an environment, certain aspects must still be thoroughly, reflectively considered through out the development of a learning environment. Due to the direct parallel between the learning environment theories and the NCATE accreditation Web site through which pertinent professional education unit documentation is made available to the NCATE BOE team, careful consideration of the human/computer interface issues must be a focus within the design and developmental process. Reflections pertaining to human/computer interface issues, concerns, and comments must be thoroughly considered so that the future endeavors will have a basis upon which to build.

Issues and Concerns

Several noteworthy human/computer interface issues and concerns were raised through out the design and development of the professional education unit's NCATE continuing accreditation Web site. Only the thoughtful, reflective consideration of each issue and concern offered useful, creative ideas that could be implemented in real-world environments that could, in turn, address the discussions surrounding each subject.

Instructional Design Model

The first of these issues was the questionable use of the Four D Model (Thiagarajan, Semmel & Semmel, 1974), a linear instructional design model, to develop an ill-structured, nonlinear, hypertext Web environment. Concerns arose surrounding the use of this model because, as the argument was delineated, the linear instructional design model may impact the ill-structured, nonlinear, hypertext Web site that was to be developed. However, after further discussion and theoretical underpinnings were discussed, the realization that a linear instructional design model does not necessarily lead to a linear product was agreed upon. A linear instructional design model, as the Four D Model clearly is, can indeed offer a product the defined requisite step procedures outlined in the Four D Model to attain a nonlinear Web environment. The basic parallel understanding between the two, descriptively the model and the product, is that the model leads the progress through out the design and development of the product; however, the product demands to be developed while focused upon its own specific goals and objectives. Therefore, the importance of a tight parallel between the instructional design model and the product goals and objectives is obvious; yet the underlying theoretical structure of the instructional design model does not drive the underlying theoretical structure of the product. The theoretical underpinnings do not necessarily have to be the same to produce a strong product.

Intellectual Property and Ownership

A second issue was the placement of faculty vitae and syllabi on the Web site. At the beginning of the developmental process, the desire to offer the professional education unit documentation and information as a freedom of knowledge endeavor drove the location and obtainment of historical information. However, as the developmental process became more engrossing, the faculty raised questions surrounding the idea of placing course syllabi on the Web for anyone to view. This concern arose due to the knowledge, history, research and reflection that was apparent through out the course syllabi; many faculty had built their prestigious careers upon the subject matter contained within the course syllabi and the faculty were not inclined to place these course syllabi on the Web for anyone to view, borrow, or use towards someone else's own personal end. Although the faculty were eager to offer their aid to anyone that may ask for information and would most likely offer their course syllabi upon request, the perceived lack of control, when placing information on the Web, was a concern. The control that was apparent through the personal contact between faculty member and the person requesting the aid was a workable situation; however, when the information was placed on the Web, it became a question of intellectual property and ownership. Anyone could take this information and do whatever they wanted to do with it. This was the concern of the faculty.

After numerous discussions and the support of the faculty, the decision was agreed upon to place password protection upon the NCATE Web site that would house the course syllabi, as well as any other documentation that the faculty agreed to include for the Web site. The question of intellectual property and ownership pertaining to the placement of course syllabi on the Web site offered faculty the opportunity to clarify the gray area of intellectual property and ownership within the professional education unit environment and, on a larger scale, the university environment.

Copyright

Within the same thought pattern as the intellectual property and ownership, the question was raised concerning copyright issues and concerns. The question of copyright, both of the historical documentation placed on the Web site and the Web site itself, was discussed through out the developmental process. The university administration is still working on the final documents pertaining to the copyright legalities; however, the concerns over copyright issues pertaining to this Web site are quite clear. If the documentation was developed for any part of the university environment during the employment of faculty, usually described as research, service and teaching, then it is the property of the university and the university will receive at least a percentage of the proceeds. However, anything is worthy of discussion and copyright may be one of these discussion topics. Therefore, the question of copyright when discussion the historical documentation that was placed on the Web site was the sole copyright of the university. Also, the Web site itself was the sole property of the university and copyright went to the university, although the theoretical underpinnings and learned lessons were the knowledge obtained by the researcher.

Template

The template structure of the Web pages within the Web site was areas of discussion through out the developmental process. The strong feelings of the appraisers pertaining to the template structure that the Web pages would follow were consistently questioned, discussed, commented upon, and complimented. The Web page templates consisted of a title bar along the top of the page, with higher-level navigation buttons directly below the title bar, listing left to right. Along the left side of the page were same-level navigation buttons that offered the ability to quickly navigate through out other relevant Web pages without the difficulty of moving within the Web site, losing the place within the Web site navigation structure, and forgetting the information of importance during the navigation process. However, one significant template structure addition that was offered by the appraisers was the desire to have an area along the right-hand side of the screen that would offer textual links to areas of related importance within the document that the user was viewing. This aspect quickly led to an innovative aspect within the Web pages that offered easier, quicker nonlinear, hypertext availability within the Web site. Although this was an obvious addition to the Web page templates, the clarity of thought on the part of the appraisers led to this innovative use of the nonlinear, hypertext environment.

Comments

Several noteworthy human/computer interface comments were raised through out the design and development of the professional education unit's NCATE continuing accreditation Web site. Only the thoughtful, reflective consideration of each comment would aid in the development of the professional education unit's NCATE continuing accreditation Web site.

Interface Format

The interface of the Web site was the first consideration within the initial design and developmental process. The desire of the developer to integrate a useful, smooth interface into the Web site that would seamlessly aid the user towards the documentation of importance was an issue that was constantly in the developer's thoughts. Interviews were conducted with the appraisers requesting feedback upon the template color(s), template text size, and overall template aesthetic appeal. Specific questions were asked concerning each templates:

- Attractiveness
- Unattractiveness
- Obvious and Easily Viewable/Readable Links
- Positive Aspects
- Negative Aspects
- Distracting Aspects
- Annoying Aspects
- Personal Thoughts Concerning the Template
- Which template(s) were preferable for the Web site

Through these overarching questions, numerous insights were gained from the appraiser responses. The appraisers, as an overall desire, found the simplistic, straightforward templates to be most attractive; the reasoning behind this was that the appraisers felt that the "busier", less simplistic templates would become more of an eyesore as the user traversed through out the Web site. Although the less simplistic templates may have been attractive for a one page template, the consistent use of the template would become difficult for the user; as one appraiser noted, the template should be an appealing backdrop for the documentation, not the other way around.

Web Browser Inconsistencies

A comment noted most loudly through out the developmental and appraisal processes was the inconsistencies between the Web browsers Netscape Navigator or Netscape Communicator (Netscape, 1997; Netscape, 1998) and Microsoft Internet Explorer (Microsoft, 1997). Although the Web site was developed for consistency in viewing across platforms and browser types, the difficulties that became apparent when developing the Web site made the simplistic aspects of a Web site more intriguing and desirable. The Web site became a streamlined structure with very few outside inconsistencies not taken into consideration. However, although all inconsistencies between Web browsers were thoroughly discussed and reflected upon, instances of inconsistencies will always arise when developing a Web site; the structure must be flexible enough to work within these inconsistencies and aid the user in the user's quest for information.

Conclusions

The importance of human/computer interface issues through out the Web site developmental process can not be underemphasized. Although the main focus of the developmental process was the placement of documentation on the Web and the interrelation of the documents within the site, the appraisers for the Web site focused upon the human/computer interface issues to a large extent. Although the appraisers were asked to comment upon structural strengths and weaknesses, the appraisers consistently focused upon the interface issues as being of primary importance. The issues, concerns, and comments concerning the human/computer interface are integral to the development of a national accreditation Web site to house pertinent documentation and must become central to the development of the Web site. Through trial and error through out the design and development process, the thoughtful, reflective nature of the appraiser feedback offered numerous instances of insight and developmental aids.

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Training School District Instructional Technology Coordinators in Multimedia Development, Instruction and Use

Caroline M. Crawford
University of Houston – Clear Lake
2700 Bay Area Boulevard, Box 50
Houston, Texas, USA, 77058-1098
crawford@cl.uh.edu

Abstract: The use of technology within the PreK-12 classroom has been steadily increasing within the previous ten-year period. However, teacher training has not kept a similar pace. The training available for the teachers, as well as the administrative-level school district employees, has lagged desperately behind the technological hardware integration. For this reason, school districts are looking towards training the personnel in the district. Universities are continuously developing such training for their students at the undergraduate level as well as graduate level, so the universities are the logical answer to the school district needs. Within southeastern metropolitan, semi-rural and rural areas within the State of Texas, several districts and universities have developed partnerships through which the training of school district teachers and administrators can occur.

Introduction

Training school district Instructional Technology Coordinators in the use, development and implementation within instruction of multimedia is an area that is only recently being addressed. The school districts have received extensive amounts of money for networking and hardware integration within the PreK-12 classrooms; however, the training that must be implemented has lagged behind the networking and hardware. The school districts have begun looking towards outside entities through which the training of the school district personnel can occur, whether through business or educational arenas. Within the southeastern metropolitan, semi-rural and rural areas within the State of Texas, several school districts have turned to the surrounding universities to develop partnerships. The universities have answered the school districts with an energetic response and are eager to offer instructional technology training to the school district personnel.

The universities are developing a pyramidal, top-down structure through which the persons trained will in turn train others, until each of the district personnel are trained. However, this training begins at the university level. The desperate need of the school districts are being met through the thoughtful integration of not only technological training, but also the modeling required to use technology as an integrated tool within the classroom environment. This modeling begins with training the independent school district Instructional Technology Coordinators. The Instructional Technology Coordinators are persons that are responsible for training the other district personnel on the use of computer software and hardware within the district. One of the primary areas in which the district personnel are to be trained is the development, instruction, and use of multimedia.

Training Modules

The first consideration when training the school district personnel is deciding upon the information that needs to be addressed. A needs assessment clearly is indicated at this stage of the process; only through a needs assessment will the desired, needed, or required subject matter be indicated and offer the ability to be addressed. Multimedia is one area that was indicated as being not only desired, but also a subject area that would be necessary for future endeavors. Therefore, multimedia was an area that would be necessary to develop a training module.

Training modules are merely clearly articulated curriculum that offers training, information dispersal, hands-on activities, and packets of information for the trainer and the learner. Such information is necessary to develop, unless a quality training module is available. For the needs of this situation, a training module was developed by the university faculty and students to aid the school district personnel in the attainment of the necessary information.

Training the Trainers

Once the needs assessment has occurred, with results leading to the development of a multimedia training module, the next area of concern would be the question of who would train the learners. The university faculty would logistically be unable to facilitate each training session, so the question follows as to exactly who would facilitate the trainings. The logical answer actually consists of two responses: school district instructional technology coordinators and university graduate students.

School District Instructional Technology Coordinators

The school district Instructional Technology Coordinators have perfect logistical positions through which to train the school district personnel. Therefore, the Instructional Technology Coordinators would be the primary focus of the university faculty. Once the Instructional Technology Coordinators are trained upon the integration of multimedia, the information dispersal would again focus upon multimedia, but upon the training towards the facilitation and integration of multimedia; in this way the trainer has the experience of being on the receiving end of the instruction as well as on the facilitating end. This two-sided experience allows the facilitator to not only empathize with the learner, but to also have the experience necessary to foresee possible problems or questions that may arise during the training sessions. However, the school district Instructional Technology Coordinators have positions which pull them in numerous different directions all at the same time; therefore, it may be impossible to solely train the Instructional Technology Coordinators as trainers due to the possible inability of the Instructional Technology Coordinators to act as sole trainers for the school district personnel. With the majority of Instructional Technology Coordinators having numerous duties, as previously stated, one simplistic answer would be to train the university graduate students as trainers.

University Graduate Students

Training university graduate students as trainers for school district personnel offers a multitude of experiences for the university graduate student. Not only will the graduate students receive real-world experience training adults in educational settings and the possible monetary compensation that would be available; but, the graduate students would have the ability to further develop one or more training modules that would be beneficial, further their knowledge of learning environments and curricular events, and develop mentor/mentee relationships with university faculty as well as school district Instructional Technology Coordinators. The graduate students could work parallel to the school district Instructional Technology Coordinators, contract their services through the university to the school districts, or numerous other combinations which would offer the experience that graduate students may desire to obtain real-world experience and develop surrounding school district contacts that may aid them in future ventures. The possibilities for the university graduate students to work with university faculty and district personnel towards the development of multimedia offer a well-rounded experience to university graduate students.

Technology Integration

The development, instruction and use of multimedia in a classroom environment open the world to numerous instances of technological integration into the educational curriculum. Through this integration of multimedia, the curriculum can be largely enhanced and the learners will have the ability to develop further knowledge and experiences that would have previously been unimaginable. For the purposes of the training of school district Instructional Technology Coordinators in multimedia development, instruction and use, three focuses of technology integration will be considered: teacher-centered technology, student-centered technology, portfolio assessment.

Teacher-Centered Technology

The development of training modules to focus upon the teacher-centered aspect of technology integration into the curriculum and, therefore, into the educational environment, offers numerous opportunities for multimedia to be integrated. Multimedia can be used as a linear or nonlinear lecture device for the facilitator, which would enhance the lecture through the integration of pictures, videos, sound files, animation, and other such facets of multimedia. The ability to integrate such enhancements into a lecture-style situation offers the ability to maintain the motivation of the learners, emphasize numerous integral aspects of subject matter, or merely display an innovative curricular entity.

However, the teacher-centered multimedia technology must not merely be used for lecture-style purposes. The ability of the facilitator to develop multimedia products that would enhance prior knowledge, develop conceptual frameworks for the learners, act as knowledge-checking experiences, or an even more advanced multimedia package can offer the ability to develop teacher-centered multimedia drills that the learners would work through as a class. The primary aspect of the teacher-centered technology is the innovative uses of multimedia within the experience. Numerous facilitators may already understand the fundamentals of a multimedia package; however, the true skill is displayed when the facilitators display their knowledge towards developing a teacher-centered or a student-centered multimedia package.

Student-Centered Technology

Student-centered technology can be further defined as instructor-created or student-centered technology. Within the area of multimedia, the ability of both the facilitator and the learner to equally develop multimedia programs for distinct purposes is an integral part of the curricular and instructional situation.

Instructor-Created Multimedia

The development of multimedia for the learner is an experience that opens a multitude of environments to the learner. The facilitator may create mere drill and practice environments through the higher-learning situations that would request critical analysis on the part of the learner. Although the facilitator must carefully decide upon the curricular integration and introductory environment through which to engage the instructor-created multimedia, the possibilities are endless.

The facilitator must have the capability to develop multimedia products that will facilitate the learning process while engaging the learner until the requisite goals and objectives are obtained. This is no easy feat, and one that must be considerably touched upon through out the training of the school district personnel.

Student-Created Multimedia

The student-created multimedia is another aspect, altogether. The ability to create educational environments through which learners can create multimedia products that have educational relevance is a carefully learned ability. The training of district personnel to have the foresight, comprehend the capabilities of the student-created multimedia products, and open the curricular and learning environment to this option is one which must be facilitated in a forthright manner. The ability of learners to create their own multimedia package of their learning opens the learning environment to one of control on the part of the student, as well as creates a collegial attitude on the part of the student. This type of environment is one that closely emulates the business, professional environment of today and one that must be carefully integrated into the learning environment for our students to emulate. Of interest is the close parallel between student-created multimedia and portfolio assessment within the educational environment.

Portfolio Assessment

The development of student-created multimedia products, and the integration of these products within a larger structure, emulates a digital portfolio. The creative, developmental work that is brought to a portfolio entails numerous hours of difficult thought patterns and critical analysis of numerous high-level situations. The difficulty within a digital portfolio, which is what is being addressed, is the assessment factor. Once the learning occurs and the multimedia product is developed and integrated into a portfolio structure, how will the portfolio be assessed?

As with numerous paper portfolio assessment structures, A reflective piece is included by the learner for each product that is included within the portfolio. Through this reflective piece, the portfolio assessor has the ability to attain a working understanding of the learner's thought process through out the developmental period and to assess the learning which took place. On a larger level, a rubric or a matrix is viable options through which to assess a portfolio. Through a matrix or a rubric, clear delineations are presented to the portfolio developer and assessor as to the criteria through which to obtain the desired grade within an organized grade structure.

Although there is a lot of information pertaining to portfolios and portfolio assessments available, the integration of technology into the portfolio environment should be openly addressed within the multimedia development, instruction and use training sessions for school district Instructional Technology Coordinators.

Conclusions

Training school district Instructional Technology Coordinators in the use, development and implementation within instruction of multimedia is an area that is only recently being addressed. The desperate need of the school districts are being met through the thoughtful integration of not only technological training, but also the modeling required to use technology as an integrated tool within the classroom environment. This modeling begins with training the independent school district Instructional Technology Coordinators. One of the primary areas in which the district personnel are to be trained is the development, instruction, and use of multimedia. Through the development of training modules, training the trainers, and technology integration, the introduction of multimedia into the educational environment is becoming a reality.

Applying Constructivist Learning Principles in the Virtual Classroom

Judith Blanchette
Educational Policy Studies
University of Alberta
Canada
(judith.blanchette@ualberta.ca)

Heather Kanuka
Educational Policy Studies
University of Alberta
Canada
(heather.kanuka@ualberta.ca)

Abstract: In recent years, much has been written on the philosophy and theory of constructivism. Only recently, however, has it become feasible to consider constructivist principles within the context of adult distance education. The participant interaction that is central to most constructivist theory has become possible primarily because of advances in communications technologies that have become an integral component in an increasing number of distance education environments. There remain a number of barriers to full implementation of constructivist principles within the context of higher education. This paper will address some of these barriers and describe how instructors in a technology-mediated distance-delivered undergraduate program designed a learning environment based on constructivist principles.

Introduction

Academic discourse relating to the value of collaborative learning appears to be based on the distinction between the individual and social nature of human cognition. The former position reflects the work of Piaget (Wadsworth, 1971) where the focus is on individual cognition. In this view, the function of the group is to provide social pressure to solve problems. This pressure stimulates the individual to resolve internal conflicts which, in turn, leads to cognitive growth. The latter position is based on the Vygotskian model, wherein the group plays an integral rather than peripheral role in cognitive growth. Knowledge is created through social interaction, and then, primarily through language (Frawley, 1997). Young (1997) illustrates the full continuum of epistemological stances relating to how humans create knowledge, the relationship between the individual and social context, and their relative impact on the process of knowledge creation. He identifies six schools of thought, each of which can be placed in one of three categories: *Category 1* in which social context and interaction are irrelevant (i. Radical, Material constructivism, ii. Critical, Final constructivism); *Category 2* in which the social environment may or may not play a role in the construction of knowledge (iii. Existential constructivism, iv. Efficient, Objective constructivism); and *Category 3* in which the social nature of knowledge construction is central (v. Social, Formal constructivism, vi. Co-constructivism). Although Young's categories are useful for describing the different epistemological positions, learners themselves are not restricted to employing any one position in their construction of knowledge. From both a developmental and contextual perspective, learners will naturally move fluidly from one knowledge construction mode to another, unless something impedes this movement. In traditional distance education, the learning environment has acted as such an impediment because it could not support the movement from cognitively oriented to socially oriented knowledge construction.

Another central tenet of constructivism is an emphasis on process. Learners should participate in authentic, active learning experiences. This presupposes a complex learning context, which reflects the ill-structured nature of real-world problems. In this learner-centred environment, the teacher functions as facilitator of learning, rather than dispenser of content. Reflection is part of the process of building knowledge, as is articulation, both internal and social. Jonassen et al. (1995) refers to these attributes as: context, construction, collaboration, and conversation. Zahorik (1995) categorises them as activating knowledge, acquiring knowledge, understanding knowledge, using knowledge, and reflecting on knowledge. The emphasis accorded to each of these facets by proponents of the different constructivist schools of thought varies. There exist a number of theories, perspectives and approaches to constructivist learning including: situated cognition (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991), cognitive apprenticeship (Duffy and Bednar, 1991), and cognitive flexibility (Spiro, Feltovich, Jacobson & Coulson, 1991). Increasingly, theorists are addressing the ways in which technology can be used to support constructivist learning environments (Duffy & Jonassen, 1992)

Barriers to Incorporating Constructivist Principles

With so much importance placed upon interaction between and among learners and instructor, and the difficulty of achieving that interaction within the traditional distance education environment, it is not surprising that distance educators found it onerous, if not impossible to reconcile constructivist principles with the reality of their working environments. The adoption of communication technologies by the distance education community has substantively removed one barrier to participant interaction, but there are a number of other factors that limit the extent to which instructors apply constructivist principles. While these are not exclusive to the distance education environment (Carr, Jonassen, Litzinger & Marra, 1998), their impact may be felt more strongly in that context.

Instructional Design

The prevalent instructional design models tend to impede the application of constructivist principles (Wilson, Teslow, & Osman-Jouchoux, 1995). The linearity of most instructional design models, coupled with the objective-driven development process, acts as a major constraint, one that is more evident in the context of distance education than it is in the traditional face-to-face higher education context. Most post-secondary instructors develop their courses with complete or near complete autonomy, but this is seldom the case when courses are developed for distance delivery where planning and development are frequently a team effort. This supports instructors whose experience with distance delivery is limited, or provides technical resources, thus freeing the instructor to focus on content. The number of proprietary software programs that have been developed to replicate this environment by providing 'course development toolboxes' for use by instructors who do not have access to instructional design teams indicates the prevalence of this development model. While taking a template approach to instructional design may ensure efficiency and consistency, it is seldom conducive to supporting constructivist principles.

Institutional Constraints

The institutional barriers to implementing constructivist learning principles identified by Carr et al. (1998) are essentially the same for both face-to-face and distance delivered courses and programs. Any differences tend to be of degree, with the distance context subject to somewhat greater constraints. The three institutional barriers we will discuss are those of textbook focus, time constraints.

The textbook focus evident in the face-to-face classroom is reproduced in the virtual classroom, but with the inclusion of an additional element—the World Wide Web. Now, instead of, or in addition to, providing printed packages of readings and study guides, these materials are often posted on course web pages. This reliance on text material may be one of the most difficult barriers to overcome, because is it is based on not only an institutional bias, but also a cultural one. There is also a possibility that because interaction within the context of computer-conferencing is mediated through text, i.e., the written rather than the spoken word, such interactions are regarded more highly by the learners than are discussions in the face-to-face classroom. Learners routinely print the comments of fellow students for future reference (Technology in Higher Education (T.H.E.) Study Group, 1998). Essentially, they treat what would be a conversation, had it occurred in a face-to-face environment, as if it were a textbook.

Time constraints place a serious limitation on constructivist learning. It takes longer to design an authentic learning environment. Complex, ill-structured activities where learners must experiment and negotiate naturally take longer to complete than do activities designed to transmit information. The time factor becomes even more of an issue when working in a text-based, asynchronous environment. It takes longer to compose a message that will be subject to scrutiny than it does to make a similar comment in class where a large portion of the message is transmitted visually using paralinguistic clues such as body language or intonation in ways that are denied to the writer. In addition, when conducted asynchronously, discussions and negotiations may be attenuated over a considerable length of time.

Learner Resistance

Adult learners are very often self-directed and independent learners. These characteristics are particularly evident within the context of distance education. Even within technology-mediated environments, many learners express a preference for content-delivery facilitated by instructional design models (Technology in Higher Education (T.H.E.) Study Group, 1998). Communication technologies can provide an opportunity for interaction between and among learners and instructors, but while many participants enjoy the interaction, fewer view it as an essential component of learning. Wells (1993) notes that "Students who are 'socialized' to the *isolation* of self-study may even need to be 'resocialized' to the educational benefits of interaction!" (p. 83). Ensuring that on-line activities are meaningful may help overcome the learner resistance that results from exposure to not only new ways of learning, but also new technologies. Interaction should not be merely an add-on to course content, but rather, an integral component of the learning experience.

Lack of Role Models

Instructors as well as learners have been socialised into a culture of information transmission as opposed to one of knowledge creation. The industrial model of traditional distance education has provided even fewer models of constructivist principles than has traditional face-to-face education. Communication technologies, however, can provide the means for distance educators to move beyond the industrial model by supporting constructivist learning principles in a post-industrial distance education context (Garrison, 1997).

That potential notwithstanding, distance educators have few role models for designing and facilitating constructivist learning environments. Teaching is an activity often conducted in isolation from other practitioners, and this is even more of a factor for distance educators. Pre-service teacher education rarely addresses the context of distance education and many, if not most, distance educators have little or no context specific instruction. Courses and programs that are available generally focus either on features of the technology or on instructional design models. There is a need for professional development activities predicated upon constructivist principles where distance educators can both observe and practise collaborative interaction.

Incorporating Constructivist Principles

The question remains--how can distance educators incorporate constructivist principles into their on-line classrooms? Over the past two years, we have instructed several sections of a technology-mediated distance education course for adult educators who were either beginning to work in distance education environments or expected to. Faced with the constraints previously identified, we have tried to create complex learning environments, facilitate learning, foster collaboration between and among the course participants, and encourage reflection. Using the six learning principles of mulitiplicity, activeness, accommodation, authenticity, articulation, and termlessness identified by Koschmann, Myers, Feltovich & Barrow (1994) as a framework, we will describe some of our activities and their outcomes.

Mulitiplicity

The principle of multiplicity refers to the multiple perspectives inherent in any authentic, ill-structured learning environment. Knowledge construction is a complex activity and the learning context should reflect this complexity. When planning for learning, the instructor needs to focus on the *complex whole* rather than on the *discrete parts* of tasks and problems. This is especially true in distance education where breaking a problem into subsections, or a series of discrete steps is a common instructional strategy. At the same time, it is essential to distinguish between a learning activity that reflects the complex nature of knowledge and a needlessly complicated learning activity. If an activity does not lead to the desired type of interaction, it is possible that the activity itself is overdesigned and interfering with or restricting interaction. The simplest of activities can provide an opportunity for a rich learning experience (Carr, et al. (1998).

The concept of multiplicity was integrated into all of the learning activities used in this course. Since one of our goals was to have students challenge their assumptions about what it means to teach and learn in a technology-mediated environment, students were expected participate in and critique course activities from the perspectives of both instructor and learner. Initially, even though the participants are themselves instructors, many were reluctant to relinquish their role of student, and we found that it was frequently necessary to actively encourage participants to experience the activities from alternative perspectives.

In order to provide students with an opportunity to assume multiple roles and perspectives, we attempted to create as authentic an environment as possible. It has been our observation that many experienced instructors new to technology-mediated distance education attempt to transfer teaching and learning strategies directly from their previous context, whether that be face-to-face or traditional modes of distance education. Since this is seldom effective, we wanted to provide course participants with an opportunity to experience, within a risk-free environment, the disequilibrium or frustration that comes with moving from the familiar to the unfamiliar, so that they would be compelled to question both their attitudes and practice. To accomplish this, we first analysed the way certain activities were typically implemented in face-to-face adult education courses and then moved them in their entirety into the virtual classroom. By dividing these activities into a series of discrete steps, we could have ensured that learners experienced greater 'success' in the class, but that would have inadequately prepared them for the process of adapting and transferring their teaching methods to the virtual classroom.

Activeness

This principle refers to the process whereby learners assume ownership of the topic or problem and explore it in ways that are most relevant to their needs. This precludes an emphasis on content (the traditional objective, information, measurement model that guides and limits discussion) in favour of the creation of authentic tasks. Since adult educators have more than a passing familiarity with the use of icebreakers, students were asked to work in groups to develop an icebreaker suitable for use on-line. We did not want to force participants to curtail their explorations of the topic in order to submit a product or to direct their focus toward receiving a grade, so no marks were assigned to the product. We also had, and still have, reservations about the tendency to assign grades to on-line activities in order to stimulate participation, when similar 'in-class' activities would not be graded in a face-to-face environment.

No two groups approached the problem in the same way since the members of each group were influenced by different factors, ranging from their experience with distance education to their attitudes toward icebreakers and the characteristics of their students. Those groups where some members had prior experience in distance education spent much more time discussing the rationale and associated problems and processes in advance of designing an icebreaker activity. Those groups whose members had no first-hand experience with distance education jumped right into the development stage, but as they experimented with different icebreakers and encountered an assortment of unforeseen problems, they began to question their initial assumptions. It would have been impossible to predict the variety of factors and resources that influenced each individual's contribution. Nor would it be possible to condense their negotiations and conclusions into a series of steps that could be used to 'instruct' another group of learners.

Accommodation

The principle of accommodation is based on encouraging learners to become aware of and challenge their assumptions at the most basic levels. One of the ways we try to help participants to accomplish this is to expose them to difficulties experienced by many distance education instructors. This enables them not only to enhance their knowledge and skills, but also to question their attitudes and beliefs about distance education and what it means to be a distance educator.

At the outset of the course, we explain the learning context to the participants and try to prepare them for a certain amount of frustration and discomfort. It should be noted here that this course is part of a program of study and that the students have already completed several courses using the technologies before beginning the one described here. In spite of our warning and their earlier experiences, or perhaps partly because of the guided, highly structured nature of those earlier experiences, the ill-structured nature of this course came as quite a shock to some participants. Since the course has a strong affective component, participants were encouraged to discuss their feelings of disequilibrium.

One activity that encourages participants to challenge basic assumptions is introduced at the beginning of the course. Again, students are asked to replicate a routine in-class activity. In this case they are asked to "get themselves into groups" and "brainstorm" a particular topic. They have one week to accomplish this before reporting back to the class. This activity brings to the forefront assumptions about group dynamics. Students compared the on-line process with what takes place in the face-to-face setting, debated the rights of adult learners to autonomy, discussed factors that influence the success of self-selection, and suggested possible alternatives for group formation. Throughout the remainder of the course, we applied these suggestions, and they were then subjected to the same critique.

It must be noted that students are not the only ones to experience a certain amount of turmoil. Even instructors who are proponents of experiential learning generally want those experiences to be positive ones. It can be difficult to let students make 'mistakes'. Instead, we have attempted to foster a culture of adventure rather than one of successes or failures. In support of this, we facilitate frequent debriefings allowing learners to discuss the process. Applying the concept of accommodation requires the instructor(s) to be prepared to adapt to the unique characteristics of each group of learners. Just as each class makes different suggestions for group formation, so they suggest creative, innovative variations on other aspects of the course. And, as the learners confront their assumptions, we too must continually identify and challenge ours.

Authenticity

An essential component of constructivist learning is the emphasis placed on the learning context. The rationale for offering this course hinges on the learning context, that is, making the transition from the face-to-face classroom to the technology-mediated environment. To this end we encouraged participants to be as descriptive as possible about their working environments, both face-to-face and virtual. What were the similarities in content, educational goals, learner characteristics, and institutional characteristics? What were the differences? This not only helped the group members understand the unique circumstances of the others, but also highlighted conflicting expectations resulting from the change in context. The process of painting these detailed pictures provided the class with a far richer context than could be provided by any individual.

At another level, we created a context for learning that encouraged risk-taking and experimentation. We wanted learners to be innovative within the virtual classroom. We also wanted them to gain enough experience that they could make sound instructional choices. Through the process of active experimentation and the discussions that ensued from these experiences, we hoped to provide a model learners would continue to use to analyse and evaluate their practice.

Articulation

Learning within a constructivist environment should be a collaborative rather than a competitive experience. To this end, students are encouraged to work together to solve problems and negotiate solutions. Participating in this way not only helps them to integrate their learning into their prior experience, but also helps them to develop communication and interaction skills that they can apply to their own instructional contexts. For learners who have been socialised to be independent learners, it can be difficult to make the adjustment to collaborative activity. And since this type of interaction goes well beyond product-based group work, it is not only the independent learners who must learn new skills. The instructor should be prepared to model collaborative dialogue. This can include, but is not limited to questioning, interpreting, elaborating upon earlier comments and synthesising the discussion. Comstock and Fox (1997) refer to this as the social process of making meaning. We should note here that using a team-teaching approach can be advantageous when attempting to model collaborative interaction.

Termlessness

At the same time that students are participating in any given activity, they are encouraged to engage in a parallel discussion about the process. In a face-to-face class it would be necessary to halt the learning activity in order to discuss the learning process or to explore one or more of the assumptions contributing to the development of the activity, but computer conferencing allows us to transcend temporal barriers. This parallel processing illustrates one of the strengths of computer-conferencing where the technology acts as a cognitive tool that supports metacognitive activities. Parallel discussions also take place in order to help participants process the affective component of the course.

Conclusion

In this paper, we have described how we apply constructivist learning principles in a technology-mediated distance delivered course for adult educators. We identified and addressed the barriers faced by adult educators who would like to apply constructivist learning theory to their distance education courses. Using a model developed by Koschmann et al., 1994) as a framework, we illustrated some of the approaches used to create a constructivist learning environment within a very specific context. Distance educators can use communication technologies to facilitate the application of constructivist principles to the on-line environment by increasing the opportunity for interaction between and among students, overcoming the temporal barrier that impedes parallel processing, and encouraging the development of authentic learning activities. If the technologies are to meet their full potential, however, researchers and practitioners must direct their attention to evaluating and implementing the principles of constructivist learning theory in order to bridge the gap between theory and practice.

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Supporting Graduate Students Training District Coordinators in Multimedia Development

Caroline M. Crawford
University of Houston – Clear Lake
2700 Bay Area Boulevard, Box 50
Houston, Texas, USA, 77058-1098
crawford@cl.uh.edu

Abstract: The use of graduate students to train surrounding independent school district Instructional Technology Coordinators is an important aspect to each of the entities involved in the situation: the graduate students obtain opportunities to display their strengths and to introduce themselves to the surrounding professionals within their area; the university obtains positive feedback concerning the strengths of their students, as well as the positive public relations displayed at such times; the independent school district Instructional Technology Coordinators are offered opportunities to learn cutting-edge technology from the university, the use of university resources, as well as the opportunity to view possible future recruits in an "on the job" real-world situation. Each of the entities has positive situations through which to explore future possibilities.

Introduction

Graduate students not only desire but also need the help of their university faculty to present learning situations to them. These learning situations are not only to aid the university in its pursuits but also, more importantly, to expand the students' opportunities to learn new situations and environments. However, the graduate students must be mentored so as to produce a positive experience within the three primary groups involved. This is where the faculty must step in and facilitate the development of the course curriculum and instructional situations. The previous experience of the faculty member can help guide the graduate students towards a positive experience for all members involved.

Hardware and Software Issues

Although the graduate student may have everything ready to walk into a training situation and successfully lead a training of district coordinators in multimedia development, last-minute issues consistently arise. Two last-minute issues have consistently been questions pertaining to software versions and computer security issues.

Software Versions

The graduate student has diligently worked to produce an awe-inspiring training module and can't wait to jump into training the District Coordinators. However, the software versions of the tools they will be using for the training that can be located on the computer hardware lag behind the version for which the graduate student has developed the training module. Although the graduate student has considered absolutely all conceivable situations that may arise and are secure in the fact that they are unquestionably ready for anything, this problem has arisen time and again. Although the graduate student has the latest versions of every single software title available on the market today, the university may lag behind. Unfortunately, this consideration may not cross the faculty member or the graduate student's mind until faced with such an issue. For the sake of all concerned with the training, especially to offer a stress reduction to the graduate student that may be faced with such an issue, it is a hard-learned lesson to always check with the institution, whether university or field-based organization, that will house the training. Not only will this offer a positive environment through which the graduate student can begin the scheduled training, but also the graduate student will feel more secure when developing the training module.

Computer Security Issues (Windows NT)

A second consideration when dealing with such basic issues as hardware and software is the question of levels of computer security. This is not usually a problem with the Macintosh operating system (Apple, 1998), unless another level of software is added to the operating system that adds a computer security issue. Yet the administrator of a Windows operating system, whether Windows 95/97 or Windows NT (Microsoft, 1995; Microsoft, 1997a; Microsoft, 1997b), can delineate the level of computer security on each computer in a training classroom. This must be discussed before the training is developed and ready to facilitate; without such discussions, surprises will occur. The computer administrator can offer numerous suggestions to the facilitator, but the suggestions are only available if the computer administrator knows there are concerns or issues that must be resolved. Therefore, the forthright inquiries and discussions between the faculty member aiding the graduate student, the graduate student, and the computer administrator where the training will occur is a strong suggestion to waylay any training-morning tragedies.

Insecurity and/or Nervousness of the Graduate Student

Whether the graduate student has made it a career to facilitate training sessions or is a novice in this realm, the insecurity and/or nervousness that any facilitator feels before the beginning of a training sessions is a natural experience. However, the extent to which a graduate student can experience this insecurity and/or nervousness may be multiplied due to the added pressure of the faculty member's expectations and the district coordinator's expectations. For these clear reasons, the faculty member may be inclined to be extra sensitive to the graduate student's needs throughout the design, development, and facilitation of the training module. For the majority, graduate students have a familiarity with trainings and professional presentations; however, there may be certain aspects of the facilitation of the training modules that may require extra sensitivity and discussion between the faculty member and the graduate student.

Interface Between the Graduate Student and the Learners

The interaction between the graduate student and the learners in the training session is of the utmost importance. Although the graduate student may be nervous, it is important for the faculty member to mentor the graduate student to present a professional demeanor. This is a "safe" situation through which the graduate student can learn their own personal training style and have the ability to try different aspects with the security of the situation readily apparent.

Become Easily Flustered

Although all presenters become flustered at one time or another in their careers, the impact of early presentations on the psyche of presenters can have long-lasting effects. Therefore, the importance of the faculty member acting as a mentor and guiding the graduate student is of the utmost importance. The graduate may become easily flustered due to the intense pressure they are placing upon themselves to do a good job. The ease with which a novice presenter may become flustered is quite higher in probability than a more experienced presenter; therefore, the graduate student must be carefully guided and aided through the first, most important, facilitation of training experiences. As the old saying goes, 'what can happen will happen', and this is doubly true when a novice presenter has taken the helm.

In spite of the fact that it is never an easy situation, when a graduate student is indeed flustered and needs assistance, the faculty member should be available to step in and offer assistance without breaking the flow of the training session. The careful assistance that the faculty member offers during the first few training sessions that the graduate student facilitates will develop the graduate student's ease and confidence for future presentations. For this reason, it is of major importance for the faculty member to carefully consider the point at which to offer assistance, as well as the subtle way in which the faculty member flows in and out of the training environment; if too obvious, the faculty member will develop a sense of insecurity within the graduate student and may impact the future presentation ease of the graduate student. Through thoughtful consideration on the part of the faculty mentor, the ability of a graduate student to become flustered may lessen.

Pace of Presentation

A difficulty that presents itself for novice presenters is the ability to check the rate at which the presentation is flowing to ensure the learners are gaining knowledge. Many novice presenters speed the training to such a point that the learners obtain very little from the presentation; yet some presenters, already mentored to take a longer period of time to ensure the knowledge is obtained by the learners, moves at too slow of a pace. Each presenter, whether novice or expert, must gauge the learner's needs and pace the presentation towards the learners in the educational environment. Although this may be an obvious presentation rule, novice presenters may need guidance to ensure the learners will be able to attain the knowledge they desire.

Vocal Range and Intensity

Many people become easily excited by a subject that they are discussing or become so wrapped up in their own nervousness that it is difficult to gauge the vocal range and intensity that is being presented. Much of this comes with experience; but much of this can be mentored and discussed with novice presenters. The vocal range of a presenter may have the tendency to reach higher octaves during presentations, especially at the beginning of a presentation. The voice range should be practiced and become a conscious part of the presenter's internal checks during professional situations. Lowering the voice merely one or two octaves offers the presenter the ability to appear calm, centered and knowledgeable even if the presenter is about to lock their knees and faint in front of the crowd.

The intensity of the voice is also a consideration worth noting. Some presenters have a naturally "soft" voice that rarely can be heard above a conversational tone and some presenters have "booming" voices that can be heard across a grassy knoll. Although both of these situations have their place in civilized company, the difficulty is gauging the desired effect for the situation one finds them in. The graduate student may particularly affected by the question of vocal intensity due to the amount of professional presentations that have been presented. The faculty member mentor can offer particularly helpful advice in this situation; although this must be carefully done. If the graduate student is presenting a training in a computer environment, the noise from the machines will add to the intensity of the student's voice; however, if the graduate student is presenting at a round table discussion, the intensity of the graduate student's voice will significantly drop. Gauging one's vocal intensity to fit the desired situation is an area in which a faculty member can mentor a graduate student.

Presentation Style

Each presenter has their own distinct presentation style; whether energetic or demure, loud or soft, structured or less structured, handouts by the ream of paper or no handouts. There is a certain format through which the presenter finds a comfort zone. Once this comfort zone is found, the presenter engages the learners in a consistent manner; however, this comfort zone is not usually yet discovered by the novice presenter. Herein the faculty member mentor has the ability to aid the graduate student.

Respect the Learners

Although this is an obvious area, sometimes people become so involved in their own insecurities that they feel the need to present themselves as the most knowledgeable for the subject they are teaching. Only they could possibly have the answers that the learners are seeking. This develops beyond the training areas of multimedia and sweeps across any subject area that is available; it seems to be a natural human reaction to insecurity. However, the learners have their own prior knowledge that they bring to any endeavor and this prior knowledge and expertise must be respected. An area of considerable concern is the way a presenter may talk to a learner; sometimes the lack of experience or security within themselves may develop into a way of talking "down" to a learner in order to feel that the presenter is the sole person in the room with the ability to offer any kind of knowledge attainment to the learner. This must be carefully watched and the faculty member mentor should work towards developing a sense of respect towards the learners within the graduate student.

Speak to the Whole Group

When nervous, it can be a natural reaction to only focus upon a specific section of the room or a certain select few members of an audience. This can sometimes make the presentation of information much less daunting to a novice presenter. But this must be discussed and the graduate student must be made aware of these faults; only through the careful integration of all learners in all areas of an educational environment will the successful attainment of knowledge be accomplished. However, the difficulty lies within the timing of mentoring the graduate student: if discussed before the presentation, the graduate student may focus too heavily upon this area; if discussed during a presentation, the graduate student may become more nervous and insecure; if discussed after the presentation, the graduate student may harbor greater insecurities concerning their presentation abilities. This is an area that the faculty member mentor must address on a student-by-student basis.

Handouts

Learners enjoy having something that they can physically hold onto, whether it is paper handouts or a CD-ROM that includes further information or merely a Web page that the learner can download at a later time. Handouts tend to give a sense of security to the learner that is felt beyond the mere presentation by the graduate student. This is an area in which the graduate students should be mentored; the format of the handouts, the inclusion of information within the handouts, and the inclusion of graphics within the handouts are all important lessons. The faculty member mentor can help guide the graduate student while learning such issues, as well as aid the graduate student when difficulties arise during the design and development process.

Write Difficult Points on a Large Board

During the presentation, questions and issues may be discussed that are easier to note or present through the use of a blackboard or similar type of writing situation. Sometimes, graduate students tend to shy away from the use of a large board on which to write important aspects of the discussion, yet this type of visual display can aid a discussion. Therefore, the graduate student should be encouraged to use a writing board when it will aid the discussion or attainment of knowledge.

Positive Feedback

Humans enjoy positive feedback if in a complimentary, sincere manner. This is an important aspect of any presentation, whether complimenting a learner on a question raised, complimenting an innovative attempt at developing multimedia, or requesting aid when a difficult part of the learning process is reached, positive feedback is important in the motivation and success of the learner. However, the majority of graduate students has been on the receiving end of the positive feedback for an extended period of time and may not have made the connection between positive feedback and the success of the presentation. The faculty member mentor can aid this situation by mentoring the graduate students in the use of positive feedback.

Move Through Out Class to Check for Understanding

The movement of a presenter through out an educational setting offers the presenter, as well as the learners, numerous advantages. For example, the presenter can check for understanding, can keep themselves from becoming a part of the "talking head" syndrome, can aid learners that may not be exactly where the presenter hopes the learners will be in the educational situation, as well as numerous other positive outcomes. The learners receive support from the presenter moving through out the educational setting through the ability to ask specific questions of the presenter in a more informal setting, become psychologically more on task with the goals and objectives of the educational setting, and make the educational setting one of a more collegial attitude. Through such simplistic actions as the presenter weaving his or her way through out the educational setting, the feeling of the environment can drastically shift to a more positive structure. This is an area that a novice presenter may not necessarily be comfortable with or be aware of, yet the faculty member mentor would strongly be urged to make mention of this simplistic addition to a presentation.

Closure to the Learning Situation

Unless previously educated as a presenter, many presenters may not be aware of the necessary closure to a learning situation. Smiling, throwing their hands up in the air and loudly stating "we're done!" is not an appropriate closure to a presentation; however, after hours upon hours of developing presentations or training modules the novice presenter may be so overwhelmed by being at the end of the presentation that they may forget their closure. However, this is an area of the presentation of which the faculty member mentor should be way and guide the graduate student. A closure, as in all presentations, is of the utmost importance and must be carefully developed.

This is the point at which most learners will remember the presenter; therefore, the closure must not only be included, but must have the strength to endure.

Conclusions

Graduate students have a multitude of abilities and strengths to offer within many situations; however, the knowledge that the graduate students bring to an educational situation may not be couched within presentation experience and training situations. The thoughtful mentoring on the part of a faculty member mentor can aid the graduate students in the development of presentation experience and training situations through the thoughtful, reflective guidance that is necessary to develop into strong presenters. Through the experience of training district coordinators in multimedia development, the graduate students have the ability to learn such important aspects of their graduate-level work as presentation and training skills.

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The ParlEuNet Project: The Role of Learning Support in Innovative Technological Environments[1]

Jan Elen
Center for Instructional Psychology & Technology
Naamsestraat 98
B-3000 Leuven
Jan.elen@duo.kuleuven.ac.be

Geraldine Clarebout
Center for Instructional Psychology & Technology
Naamsestraat 98
B-3000 Leuven
Geraldine.clarebout@duo.kuleuven.ac.be

Abstract: Evolutions in education lead to an increased use of problem-based learning and a variety of technologies. This contribution discusses the issue of support in technologically rich, problem-based and collaborative learning environments. Five dimensions of support are identified: amount of support, topical object, formal object, delivery system and timing.
In the ParlEuNet-project, an European project, four different support models will be investigated in a rich technological, problem-based learning environment. Two models relate to access to a dedicated database, the two others relate to the role of the teacher.

Introduction

New information delivery and communication technologies open a whole new world of opportunities and possibilities to access information and to communicate on an international level. These technologies are entering schools, which generates questions on how to use these effectively in regular class situations.
At the same time, new insights in learning and instruction have resulted in a shift from teacher-oriented towards student-centered education and from encyclopedic towards problem-based instruction by presenting ill-structured tasks and supporting learners. Teachers become facilitators of learning in the process of gaining knowledge.

The question on the amount and kind of support to be provided is becoming of paramount importance to integrate new technologies as valuable tools in powerful learning environments. How the question on support is answered depends on the theoretical stance that one takes with regard to learning. In this contribution a moderate constructivist view on learning is adopted.

In this contribution first the issue of support is analyzed theoretically. Next, it is discussed how support is dealt with in the ParlEuNet-project. In this implementation and research project the issue of support in a technologically rich, problem-based and collaborative learning environment is addressed directly.
In the conclusions it is specified how the ParlEuNet-project studies the support issue.

The Issue of Learning Support

Given the acknowledgement that not all learners are willing to execute all necessary learning activities (Elen, 1992; Jonassen, Mayes & McAleese, 1991), it is accepted even by constructivist that instruction has primarily a supportive role (Elen, 1992; Lowyck & Elen, 1991). Support aims at enabling the learner to engage in appropriate learning activities.

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Quality of instruction is dependent on the choice of the tasks and the adaptation of support to what is actually needed by individual learners and/or group of learners. In view of deciding about support, an analysis of different dimensions of support is required.

Dimensions of Support

Decisions about support can be situated on different dimensions (Elen, 1995). Each of them will be discussed.

1. Amount of support: the learning process is seen as an active, constructive, cumulative and situated process. The learner should determine his/her learning goals, select appropriate activities and find a way to fulfil them. The necessary amount of support will depend on the extent that the learner is able and willing to construct his/her own knowledge. Consequently, the amount of support has to decrease with increasing knowledge, ability and motivation. Indeed, research demonstrated that the relationship between amount of support and learning is curvilinear, both insufficient and excessive support is detrimental (Clark, 1989). Support has to be adapted to the specific needs of individual students. A gradual withdrawal of support is generally advocated. After a period in which cognitive activities are modeled by the instructional agent, the learner is gradually more and more activated to execute cognitive and metacognitive activities. Finally, all explicitly-designed support is removed and support is to be actively requested by the learner (Dillemans, Lowyck, Van der Perre, Claeys & Elen, 1998).

2. Topical object of support: the second dimension relates to the topical object of support. This topical object especially relates in rich technological, problem-based and collaborative learning environments to different levels. With respect to problem solving students will need support on both the process of solving a problem and the content of the task.

Collaborative learning increases the need for support on the group and the individual level. Students working in group will benefit from guidance on the process of working in group, role division, work distribution and balancing individual and group needs. A technological environment adds a fourth level. Students may require support to use the technological tools. Students need to know how the tools work and what can be done with them for solving the task.

3. Formal object of support: Support has also a formal object that relates to the student characteristics targeted by support. Support may be directed towards students' prior knowledge, (meta-)cognitive skills or motivation. Each of these learner variables, sometimes combined in a 'learning style', may be the formal object of support (Dillemans, et al., 1998). If lack of motivation is the major problem or prior knowledge is, support will differ.

In the research, attention has shifted from prior knowledge as the formal object of support to metacognition and motivation. This parallels the shift from encyclopedic to problem-based learning.

4. Delivery system of support: A fourth dimension pertains to the system through means of which the support is delivered. Decisions relate to the extent to which support is embedded in technology, made available through means of textbooks, or delivered by peers or a teacher. In rich technological, problem-based, collaborative learning environments support can be delivered through a variety of means. With increased technological possibilities, support can be easily embedded in the technology or delivered through the technology rather than by a teacher.

In a problem-based environment, support is partly embedded in the task. The task must connect to the prior knowledge of students as to trigger interest and motivation. In a collaborative environment, other members of the group may also deliver support (explaining, solving problems).

The question of what delivery system to use for what kind of support is basically a question of efficiency. Some support may be more easily provided by technology, other by teachers or peers.

5. Timing of support: The last dimension, timing, has several aspects. First, given the curvilinear relationship between learning and support, one may expect the need for support to decrease with growing prior knowledge, cognitive ability and motivation (Vermunt, 1992). Secondly, in the 4C/ID model, van Merriënboer (1997) has suggested that in order to be effective some support (e.g. explanatory information) has to be delivered up-front and some support just-in-time.

In a rich technological, problem-based and collaborative learning environment, support on the different topical levels must be delivered at different times. Technology enables to build just-in-time support systems. However, technology itself also requires just-in-time support. Students need support immediately if technology fails. For solving a problem and working in group, support can be given in advance by for instance explaining the principles of group work and the different steps in problem solving. Similarly, moments of orientation and reflection during problem solving can be well-suited for up-front feedback, by anticipating problems based on passed experiences.

The Role of the Teacher in these Different Dimensions of Support

Teachers in rich technological, problem-based learning environments are no longer the 'experts'. Rather, the role becomes one of providing resources and managing mediating interventions in order to enable learners to achieve learning goals (Devine, 1994). The teacher becomes a coach or learning facilitator (Elen, 1995; Roblyer, Edwards & Havriluk, 1997) and delivers support in accordance to this role. In a problem-based student-centered learning environment support is aimed at helping students to perform optimally. The teacher can temporarily provide adequate support in order to enable students to function within their 'zone of proximal development'. Through this support students may perform on a level just above their current level of performance.

The topical object of teacher support in rich technological, problem-based and collaborative learning environments is directed to all levels. Teachers support use of the technology, problem solving, working both in group and individually. The formal object of this support may differ; and is to be adapted to the specific needs of the students.

The ParlEuNet-Project

The ParlEuNet project aims at creating a problem-based, student-centered rich technological learning environment in which students from 12 secondary schools in 7 countries may learn about the European Parliament. With the following three main pillars, the educational use of technology is focussed upon:

(1) A problem-based learning environment is offered in which students work on a multi-dimensional problem. In view of acquiring problem-solving and information-processing skills, the task constitutes a real and ill-structured problem. Moreover, motivating to students and allowing them to apply a variety of information-processing and problem-solving skills.
(2) In the ParlEuNet-project students work in groups with peers from their own classgroup and from classes in different countries. The task has to allow for meaningful and international collaboration, sufficiently complex and encourage co-operation in view of cognitive load distribution (Hmelo, Guzdial, & Turns, 1997). In the ParlEuNet-project students receive a problem related to the world of work from a member of the European Parliament. Students are requested, together with students from internationally spread schools in other countries, a functional policy document on employment by following the regulations of the European Parliament. A minimum of structure must enable students to finish this ill-structured problem within 32 hours.
(3) In order to solve the above described task, students get access to a variety of information and communication tools: a dedicated database with information on the European Parliament and the task, word processing, spreadsheet and presentation tools, access to the Internet; free access to telephone and fax, an e-mail based communication tool with white-board facilities and finally access to video-conferencing once a week for communicating with their peers in the other schools. Students themselves decide on the use of these tools.

Support in the ParlEuNet-Project

An important question in the ParlEuNet-project addresses the issue of support. Some of this support will be equal for all students and some will be variable. All students will get support on the level of solving the problem; they will get the same task and sub tasks; collaboration and working with technology. For solving the task students may rely on a project booklet, containing a description of different problem solving steps. The booklet also contains help for working in group (roles and work division) and some explanations on the use of the tools are given as well.

Four support delivery systems can be identified: booklet, teacher, technology and peers. While the booklet is identical to all students, support delivered by teachers and database is not. Both delivery systems have two modes (Tab. 1). First, access to the dedicated database is 'open' or 'scaffolded'. In the 'open' mode, students have access to all the information in the database at any time. In the 'scaffolded' mode, students can get hold of all the information, but access to the information is structured in line with the specifications of the 4C/ID-model (Van Merriënboer, 1997) and accommodates the specific role of the student (for example, a student with an 'expert' role will be oriented towards using the information on the specific topic whereas a student with a 'liaison officer'-role will be oriented to the information on publication regulations of the European Parliament).

With respect to the teacher as a support delivery system two models will be studied: a pro-active and re-active model. The teacher models in the ParlEuNet-project do primarily differ as to who takes the initiative to deliver support. In the case of pro-active support, the teacher is part of the group that works on the task and may –as any group member- take the initiative to assist the students in their work on the task. In the re-active support group, however, the teacher is not part of the group but functions as an independent process-oriented consultant. In the re-active support mode, teachers will assist students only upon their request.

		Database access	
		Open	Scaffolded
By teacher	Pro-active	6 schools / 72 students	6 schools / 72 students
	Re-active	6 schools / 72 students	6 schools / 72 students

Table 1: Four types of support in the ParlEuNet-project.

The Pro-Active Teacher

Support in the pro-active mode will be primarily cognitive apprenticeship-like (Collins, Brown, & Newman, 1989). Apprenticeship originally pertained to the process where novices are acculturated in an industrial setting by means of externalizing or verbalizing the internal processes or activities involved in expert problem solving (modeling), coaching, and scaffolding (Mandl & Prenzler, 1991). In a cognitive apprenticeship-environment, the acquisition of cognitive skills is focussed upon. Students are encouraged to engage in complex problem solving, collaboration and reflection in view of the development of cognitive skills. A teacher may model a cognitive skill, coach learners in their attempts to execute the skill and execute sub tasks learners are not yet able to execute successfully. In the ParlEuNet-project the students are acculturated in the process of international collaborative problem-solving. The pro-active teacher will be part of the working group and will help students while identifying problems, organizing the work, communicating with students in other countries, retrieving information, drafting a report, ... by modeling, coaching and scaffolding. This support by the teacher is not product-oriented (finishing the task) but primarily directed towards the development of cognitive skills and, hence, more autonomy of the students. The students themselves remain responsible for executing the task.

The pro-active teacher is a full member of the problem-solving group. Together with the students, teachers work towards realizing the task. As any pro-active group member would do, the pro-active teacher may anticipate the needs of the students and make suggestions on how to solve the problem. For instance, the pro-active teacher may, even before the student asked for it, suggest places where relevant information can be found to a student who is looking for information.

The Re-Active Teacher

Support in the re-active mode is based primarily on discovery learning ideas and insights, with an emphasis on self-direction and intentionality in learning (Bruner, 1966). Discovery learning starts from the idea that cognitive skills, like problem solving, emerge gradually as a consequence of successful coping with the environment. These cognitive skills can be brought on their optimal level by sensitization and activation through repeated experiences of their successful use (Crutchfield, 1966). This implies that, in order to experience success, students will explore and experiment with the environment, without real guidance of the teacher. The impulse for exploring and experimenting in the environment lies in the task. Two sources will make students intrinsically motivated to work on a task (Bruner, 1966), curiosity and the drive to achieve competence. An 'authentic' and challenging task that can be achieved and appeals to the curiosity of students will be motivating to students and reduces the need for extensive teacher support.

In a discovery learning approach, the teacher extends the student's range of experiences, by providing the students with opportunities to explore a situation and by encouraging students to generate and test multiple hypotheses. The teacher is part of that environment, as an information resource (Bruner, 1960). But, the students will be enabled to 'discover' everything themselves. Students take the initiatives. The teacher only provides an environment and challenges the students in order to promote reflection (Jonassen, 1996).

In line with these principles, the re-active teacher will wait until the students ask something, his coaching is based on past experiences of the group. The re-active teacher acts like an independent, process-oriented consultant to the collaborative learning group. On technical and organizational questions, direct answers may be provided, in all other cases answers of the teacher will aim at encouraging students to reflect upon their activities and explore alternatives.

Conclusions and perspectives

As previously indicated, the ParlEuNet-project is both an implementation and a research project. In the above the support and its implementation in the ParlEuNet-project has been presented. The project enables to study the issue of support in depth. The effects of the four 'support models' are investigated. As such, the ParlEuNet-project constitutes a real example of a design experiment. At least 72 students will receive support in line with each of the four support models (Tab. 1). The project aims at identifying the effects of these four support models on:

- quality of the policy document produced by the students;
- knowledge of and attitudes towards the European Parliament and its operations;
- attitude towards the educational use of technology; collaborative learning, and problem-based learning;
- students' use of technology during the project sessions, and
- students' use of cognitive, meta-cognitive and collaborative strategies during the project sessions.
- change in epistemological beliefs of the students

Student characteristics (prior knowledge, interest in the task, cognitive ability, gender and cultural background) will be taken into account as co-variates. With respect to teacher support the two main research questions are:

1. Can differences in epistemological beliefs, attitude towards technology, problem-based and collaborative learning after the project, be explained by (interaction between) the amount and kind of support on the one hand an students characteristics (prior knowledge, (meta)cognitive skills, attitudes) on the other hand?
2. Can the patterns of cognitive information processing and communication activities be explained by (interaction between) the amount of support on the one hand and student characteristics on the other hand?

In order to answer these research questions a classical pre-test, post-test research design has been opted for. During the actual work on the task students' activities are monitored in order to identify differences between groups in the use of cognitive, meta-cognitive and collaborative strategies. Additional data will be gathered through means of the log-files that will keep track of students' use of the database and of the communication tools. As much as possible, readily available research instruments are used. In some cases, however, (e.g. measuring prior knowledge of and attitude towards the European Parliament) specific instruments have to be developed. For measuring the prior knowledge and attitude towards the European Parliament a questionnaire has been developed, which will be administered three times: (1) at the start of the project, (2) at the end of the project and (3) 10 weeks after the project. This will give us a better view on the evolution that students went through and whether there are differences between the different conditions.

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Computer Mediated Communications: Changing Patterns Of Academic Research In The Uk

P.Fung
Institute of Educational Technology
Open University
UK
p.fung@open.ac.uk

Abstract: The use of Computer Mediated Communications (CMC) has brought change in our ways of communicating with others. This is self-evident in the world of commerce and it seems intuitive that this should also hold true within any community whose use of CMC has become widespread. This paper considers the nature of change, if any, that CMC has brought about within academic research communities. A pilot study with groups of academic researchers is used as the focus of discussion. Some 'changes' brought about by the use of CMC in academic research were obvious and unsurprising. Other changes, though less obvious, may be more significant in bringing about change in approaches to academic research. The paper concludes by touching on what was seen by participants as not only the enabling aspects of the use of CMC but also ways in which CMC must develop in order to be used effectively in academic research.

Introduction

The development of Arpanet in the USA and subsequently of university academic networks in Europe such as JANET and EARN has contributed to Computer Mediated Communications (CMC) being available in British universities for the last two decades. It is in recent years, however, that easy access to CMC has become more generally available to academics of all disciplines in British universities. Patterns underlying the increase in CMC use within UK research groups during this time span are discussed in (Fung & Weerasinghe, 1998) and can be situated within the literature of innovation adoption (Rogers, 1995). While research into the speed and manner of adoption of CMC within communities (Kerr & Hilz, 1982, Lea et al, 1995) is in itself an area of research interest, the focus of this paper is on the implications and potential effects of the widespread and increased adoption of CMC in academic research. Discussion of these is based on the outcomes of a pilot study undertaken in the spring and early summer of 1998 as a first investigation of how UK academics perceive the use of CMC in their research work (Fung, 1998).

The term CMC covers the transmission of computer mediated data over a wide range of communication channels, from computer text, through audio to visual and possible combinations of each. In this pilot study the term was used with reference to electronic mail. This particular means of CMC was chosen for investigation because it is the medium which has been available to academics over the longest period to date and is arguably still the medium most widely available to academics in the UK. This being so, looking at the use of email in academic research seemed a promising way of beginning to track any changes in approaches to research due to the influence of CMC.

In the following sections of this paper, a brief description is given of the study that was undertaken. The outcomes of this study are then used as the basis for a discussion of email as a research tool and areas of change in academic research which the increased use of email may influence. The paper concludes by summarising what participants in the study saw as the most effective use of this type of CMC and aspects of its use which merit further research.

Overview of a Pilot Study and Outcomes

The aims of the pilot study briefly overviewed in this section were threefold. They were to gather the perceptions of academics concerning the use of CMC in research; to identify any areas of change in approaches to academic research brought about by its use and to make a first assessment of its perceived effectiveness as a research tool. Six academic research groups were approached and invited to participate. Four of these groups are based at the Open University, Milton Keynes, UK, while one is based at Leeds University, UK and one at the University of Surrey, UK.

Participation in the study was voluntary and in each of the six research groups taking part in the pilot study, email facilities were well established and available to group members. A self-completion survey was distributed to members of each participating group and seven participants took part in individual face to face interviews, during which aspects of their use of CMC were explored in more depth.

A Broad Picture

The purpose of the self completion questionnaire was to establish a picture of email usage among the researchers surveyed, their perceptions of its use in research, the advantages which they saw this technology brought to their research and what they saw as problematic in its use. In total 84 researchers were surveyed and completed questionnaires were returned by 54, representing a response rate of approximately 64%.

In establishing email usage, responses showed that, as expected, most participants had easy access to email at work, though there were two exceptions. Most used it on a daily basis, though again, relating to access, there were two exceptions, both of whom used it less frequently. In all groups surveyed responses indicated that the bulk of administrative messages in their institutions came via email.

In investigating the role that email played in participants' communications with colleagues, over 80% indicated that the statement 'I usually use email rather than the phone to contact colleagues' was true for them, while only 7% agreed with the statement 'normally the phone is my first choice for contacting

Participants were asked to rate their perceptions of the use of email in helping to establish research contacts 'that they might not otherwise have made'. Broadly speaking, the role of email in making research contacts that would not otherwise have been made, was seen as 'definitely' helpful. At an international level, by 33 (61% of respondents), at a national level by 31(57% of respondents) and within their own institutions by 19 (35%), i.e. it was seen to be more instrumental in establishing research contacts in proportion to the geographical distance of potential contacts.

Perceptions of the usefulness of contacts which had been made in this way followed the same pattern in that those made at an international level were seen as 'extremely' useful by 21 (39% of respondents), rating higher than the usefulness of email-instigated research contacts at national and institutional levels.

A common feature of many email systems is the facility to subscribe to groups or lists of users with specialist interests and to participate in discussions within those groups. The majority of respondents subscribed to lists or conferences while there were relatively few who did not subscribe to any. Reasons given for not subscribing to lists or conferences were lack of time to 'get round to it', given by one respondent and a feeling that the contents rarely proved to be useful, given by four respondents.

The majority of those surveyed only skimmed messages from lists or conferences (61%) and rarely participated directly in discussions or information exchange. For many, however, 59% of respondents, an important use of list or conference subscription seemed to be one of information dissemination, redirecting any messages considered as being of interest to other colleagues.

Of the 46 respondents who did subscribe to email lists or conferences, 9 people, almost 20%, indicated that they did not find them useful. An explanation given by three of those respondents subscribing to email lists or conferences but reporting that they did not find them very useful, was 'a lack of time to read the contents'. This lack of time was seen as current but not meriting unsubscribing. These respondents shared the view of another two respondents who did not find 'lists' very useful but still subscribed to them in the hope ' that one day a really useful message that was highly relevant would arrive' and that this made continued subscription worth while.

Participants were asked what importance they attached to email as a research tool at three stages of their research, i.e., planning, information gathering and dissemination. Overall its role was seen by respondents as most important at the information gathering stage (39 respondents - 72%), less so at the stage of dissemination (33 respondents - 61%) and least important at the stage of planning research (30 respondents - 55%).
Nevertheless 39 respondents, i.e. over 70%, felt that email had changed how they planned and carried out their research. In addition to that percentage, six respondents (13%) indicated that email had not changed how they carried out their research, since email had always been available to them and had always been used by them as a research tool.
Responses given to the question 'What sort of differences do you feel email has made to the way you carry out your research?' showed that the principal ways in which respondents felt that email appeared to have made a difference. These were that; it had helped them widen and increase the number of their research contacts; assisted academic collaboration and was a practical help in planning and implementing their research. The category of 'other' ways in which email had made a difference included two threads. In one, three respondents noted the way in which email had changed the pattern of relationships between researchers as supervisors and their research students. In the second, two respondents commented that requests for information and replies to these requests could be sent off with too little thought so possibly encouraging a 'lazy' attitude to research.
Participants were asked 'What do you see as the biggest disadvantage of email as a research tool?' and 'What

Of the 50 participants who replied to the question 'What disadvantages do you see?', 10 respondents (20%), saw no disadvantages, while from the other 40 responses, it is clear that the sheer volume of information and communication is seen as the biggest disadvantage.
Replies showed that the speed and immediacy of email and the scope it allows for widening research contacts is clearly viewed by most (27 participants - 50%) as its biggest advantage, followed its use as an information resource. Its use in establishing collaborative research and in facilitating document exchange as a part of collaboration and the benefits of its asynchronicity were noted by 9 respondents (17%).

In Summary

This broad picture of the 54 researchers responding to the questionnaire shows that while all but two have easy access to email on campus, 60% see it as useful for making and establishing research contacts at an international level. 70% feel it has changed the way they carry out their research and 85% of those replying subscribe to email lists or conferences (though the principal activity in relation to these is to forward items to colleagues). The biggest advantage of using email as a research tool is seen to be its speed and immediacy, the biggest disadvantage is felt to be the volume of communications that it generates. Looking in a little more detail at the data which contributed to this broad picture, however, showed some responses which were not quite so in line with what might have been expected and which indicated areas that would be interesting to probe further. To some extent this was done within the framework of the personal interviewing which took place. In other areas it was change which is not taking place which was of note and this too will be discussed in the following section.

Discussion

As one participant did, it is perfectly legitimate to ask the question 'what does it mean, to use email as a research tool?' Within the context of this study, the answer to that question is 'to use email to facilitate the processes involved in carrying out academic research'. All six groups who participated in the pilot have good email facilities and all are active research groups. As results showed, using email in academic research work, as a research tool, is well embedded practice within these communities. The majority of participants (82%) recorded that they usually use email rather than phone to contact their colleagues. Over 75% find it useful for making research contacts, approximately 70% feel that email has to some extent changed how they undertake and carry out their research, while another 13% have always used email in their research and as one researcher noted, 'couldn't imagine doing research without it'.

In most areas of questioning the results given in the previous section were similar across all groups. Since the groups participating in this pilot were relatively small in number, comparisons among groups could, in any event, only be made on a tentative basis. In practice, there were only two areas in which different 'group' responses might be interesting to consider further.

The first related to the preference for email contact with colleagues. Here, within a humanities research group, there appeared to be a much lower preference for email as first choice of contact with colleagues. Only just over half of respondents in this group (5 out of 9) agreed that they usually used email rather than phone to contact colleagues, the lowest proportion in all groups. It is possible that this may be an indication of a discipline difference in adoption of CMC, as suggested by (Alsop et al 1997), but would obviously need to be investigated with larger samples.

The second apparent difference between groups occurred in importance given to the role of email in research dissemination. Here, in one group, 7 out of 11 (over 60%) saw email as of major importance at the dissemination stage of their research, in comparison with a much lower proportion in all other groups. This, too, may relate to a 'discipline' difference, since many of this particular group's activities focus on development of communication technologies. However, though they may appear interesting, differences within groups of such small numbers have to be treated with caution and can only serve to highlight areas of further investigation.

These possible group differences apart, overall the outcomes indicate that these researchers see email as an essential and integral part of research work. The importance of email in making research contacts is seen as considerable and outcomes indicate that it does facilitate research processes and is seen as having effect on the processes involved in research.

Some of those effects are unsurprising. In many ways the role that email plays in facilitating contacts is simply to do what the phone and the letter previously did, but more efficiently and faster. To recall those advantages, asynchronicity removes an element of uncertainty that exists with phone calls. Messages may be composed, revised and sent, regardless of the recipient's presence at the expected location and can contain a detail and amount of information that would be impractical to leave on an answering machine. Messages that have the equivalent status of hard mail can be sent over distances and at speeds that could not be matched by traditional postal services. The effect on the research process appears to be one of speeding up and widening the scope of research contacts.

Similarly, some effects on research methodologies employed in the research process can be viewed as allowing the same processes to be carried out with more efficiency and to reach a wider audience. Respondents mentioned the fact that, as noted by (Foster, 1994), research surveys can be carried out with one electronic posting and qualitative data obtained via email is by nature of the medium 'on-line', thus eliminating the need for transcription. Only one participant in the study, however, reported having used email as a means of carrying out research surveys. This may relate to the relatively small number of participants whose research would encompass that research method. It may also relate to the fact that within the UK, as yet, for other than very specifically targeted populations, survey sampling using this medium would be affected by level of email access and usage (Selwyn & Robson, 1998).

Since inevitably the ease and breadth of transmission result in more research surveys reaching more people, no less surprising is the disadvantage, noted by two respondents, of more people receiving more unwanted surveys via email.

While the effects mentioned above could be classed as unsurprising, there were two areas in which results from the pilot study indicated effects on research processes that seemed more surprising.

One of these was the effect of email on the process of postgraduate research training. Research into the use of email in teaching and learning at undergraduate level is not new (Wild & Winniford, 1993; Pitt, 1996) and is ongoing, particularly in institutions where distance education is the principal teaching mode, as in the Open University, UK. Less researched is the effect of using email in postgraduate research training. An essential and integral part of practising research is sharing and passing on research knowledge and knowledge of research methods from skilled to apprentice researchers. This is principally achieved in the tutor/supervisor relationship and by research training courses offered as part of the 'research training' package to postgraduate student researchers.

Communication between supervisor and student researcher, i.e. mature and apprentice researcher, plays an important part in this process and it is here that email may be bringing about a subtle change. Responses from participants indicated that one of the advantages of email was improving research student/supervisor communications. This was investigated further during interviews with seven of the participants. Discussion with both mature and apprentice researchers suggested that the use of email could be instrumental in bringing about change in the nature of the student/supervisor relationship.

At base this seems to relate to the asynchronicity of email and to the perceived greater informality of the medium. At one level, email means that student and supervisor are able to be in more frequent contact than would traditionally be practical. The asynchronicity of email allows messages to be sent, replied to, without imposing or requiring a 'physical' presence as would happen if the question/information was delivered in person or conveyed via a phone call. At another level, interviewees referred to the ease with which they felt they could communicate by email within this student/supervisor relationship. This suggests that, perhaps, the perceived informality of the medium may encourage a more spontaneous communication between supervisor and student than would traditionally exist. To quote one interviewee 'the relationship is more like one of

This perceived informality is also shown in the way in which respondents felt that it was an 'easy' way of making contacts with other researchers. No relevant interviewees spoke explicitly of 'training' students to use email to approach and make contact with leading experts in their research field. In two cases, however, it was clear that it was expected of students that they would do so. Students were encouraged to read, as part of research training, material which summarises and explains to apprentice researchers how best to make use of email's potential in making research contacts (Agre, 1997).

The other area in which, from the survey responses, email appears to be effecting a change of approach is in academic research writing. Changes email had brought about in collaborative academic writing were mentioned both in replies to the questionnaire and in discussion in interviews. Changes were principally seen as positive, though some misgivings were expressed.

Email was seen not only as widening the scope for collaborative writing, but also as a way of allowing a greater freedom in collaboration, since documents could be so easily exchanged, amended and added to among collaborators. One interviewee expressed it as the opportunity to incorporate ideas and revise documents in a way that would have been impractical before electronic communications were available.

It was also noted that using email to transfer documents and to discuss current writing meant that it was easier to obtain peer feedback more easily at an earlier stage and on a wider basis, thus making a positive contribution to the quality of papers.

An aspect of this greater freedom afforded by the speed and ease of document exchange and editing, however, that aroused some misgivings from another interviewee, was the fact that this could and did mean that sometimes collaborative research writing could be more difficult to bring to closure.

It appears from the pilot survey that it is in these two areas, research apprenticeship and in academic writing, that email seems to be bringing about or have brought about, changes in research practice.

In contrast, there appears to be one change, which email might have been expected to bring about, but which, according to data from the pilot, it has not. List and conference membership, while very common, does not seem, for the majority of respondents, to have instigated its frequent use for scholarly discussion. Work by (Berge & Collins, 1995) indicates that CMC has great potential for promoting scholarly discussion, but, with one exception, this was not apparent from the pilot data. Rather than an opportunity for increased scholarly discussion among specialist groups, participants in the pilot appear principally to use these groups as 'information sources'. Responses indicate that the majority of participants see access to lists and to conferences as an indirect means of disseminating research information. Certainly, in one sense this is contributing to scholarly discussion, but not in the direct way that one might have supposed.

Conclusion

Considering the outcomes discussed in the previous sections, there are aspects of email use that have 'changed' the way in which research is carried out. In some areas this change is simply one of moving to a medium that facilitates faster communications and allows more widespread and varied research contacts than was previously possible using paper-based and telephone communications. This type of change will continue, as the technology develops and is seen as positive and enabling. A number of comments were made about the problems of 'incompatibility' of mail systems, the difficulties of attaching documents, of downloading documents and of the 'overload' of information. To increase the effectiveness of email as a research tool these issues must be addressed and given time these technical 'challenges' will no doubt be resolved. Academics too, will presumably in time become more adept and at home with the technology, employing information 'management' techniques and making more use of information 'filters' as they become available, to maximise the efficient use of CMC in their research.

In other areas, changes being brought about by CMC could be more significant since data indicates that the use of email may well be influencing the ways in which research is planned and carried out. In the study reported here, email has been taken as the medium to investigate the use of CMC as a research tool. There are possible indications (and given the scope of a pilot investigation these can only be interpreted as possible indications), that its use is influencing the researcher / student researcher relationship, the process of research apprenticeship and that it could be contributing to change in the process of academic research writing. If this is so, then the increased use of CMC, widening access to the Internet and greater availability of new computer based technologies is likely to hasten and highlight those changes. The pilot study undertaken indicates that these are areas that merit investigation in more detail and on a wider basis. Doing so would contribute to incorporating the most positive aspects of change that CMC is bringing about or likely to bring about in academic research.

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Implementation of Hypermedia System for Helping Teachers Teaching Method of Mathematics with Real Classroom Video

Suk Hee Wang
Daelim College, Computer Science Department, KyungKi Do, Korea
Technology Based Learning & Research, Dept. of Educational Media & Computer
Arizona State University

Abstract

The demand of developing educational multimedia systems has dramatically increased. Especially web-based hypermedia systems can be valuable for the public to use. However it is very complicated to develop large hypermedia web-based systems with big capacity. This paper will present math•ed•ology™ system, an interactive, hypermedia, web-based professional development program. I will also explain instructional, technical and interface design as well as the implementation of math•ed•ology™ system from a developing and programming point of view.

I *propose the effective method of programming for large hypermedia systems to reproduce using basic templates with naming conventions and alias (dummy) media files which contains file pointers only.* And also evaluation of the math•ed•ology™ system is given by using Gagne's Nine Events of Instruction.

1. Introduction

The demand of developing educational multimedia systems has increased enormously recently. Especially web-based hypermedia systems can be valuable programs for the public to use. However it is very complicated to develop large hypermedia systems including all the different types of media files such as text, image, graphics, audio and video. Many program developers have asked themselves "Which developmental tool is the best if the size of the multimedia systems is large?" and "What kind of developing method of huge size of hypermedia systems is the most effective?" and "How can we evaluate the systems once they are developed?"

We had the same types of questions at the beginning of math•ed•ology™, which is an interactive, multimedia, web-based professional development program, at the developmental stage. TBLR (Technology Based Learning & Research at the Arizona State University, Educational Media & Computer Department) team made an effort for more than two years to develop math•ed•ology™. This paper will highlight the following points from the vivid developing experience. Section 2 will present overall constitutions of math•ed•ology™ system. I explain instructional design, technical design and interface design. In section 3, I present implementation of math•ed•ology™ system from development and programming point of view. Section 4 shows evaluation of the math•ed•ology™ system is according to Gagne's Nine Events of Instruction. Nine events are the follows: Informing the learner of the objective, presenting the stimulus material, providing learning guidance, eliciting performance, providing feedback, assessing performance, enhancing retention and transfer, stimulating the recall of pre required sites capabilities, and gaining the user attention[1]. Section 5, presents a conclusion and future work. The full twenty-five lessons of math•ed•ology™ are now available on the web site **http://mathedology.ed.asu.edu.**

2. Design of math•ed•ology™ system

math•ed•ology™ is an interactive, multimedia, web-based professional development program. It is designed to increase student achievement by increasing educators' knowledge of the NCTM(National Council of Teachers of Mathematics) discourse and curriculum standards, as well as, bilingual and ESL strategies. The user is identified as in-service and pre-service mathematics teachers, staff development personnel, and professors of mathematics methodology for pre-service teachers. The program is a comprehensive resource that includes a database of twenty-five elementary school mathematics lessons on a variety of topics. 'Solving an array problems', 'Symmetry', 'Multiples with Calculators', and 'Perimeter Search' are the examples of the lesson titles. These lessons are taught in English, Spanish and bilingual formats.

The lesson provides a rich environment within which educators can see live lesson video of actual classroom instruction, and are accompanied by analytic commentary from: Mathematicians, Mathematics Educators, Language Specialists and Classroom Teachers. Each lesson is preceded by a set of focus questions, a list of user outcomes, a description of the setting and context, a lesson plan, language and teaching strategies, and applicable discourse and curriculum standards. A section on mathematical concepts accompanies the lessons and details the concepts addressed in the lesson. And also illustrative animations are given to help understand concepts. Language

Environment explains how the classroom students constitute in terms of the language they used. A pre-interview and post-interview with the classroom teacher provides insight into the perspective of the actual classroom instructor. The teacher describes expectations and objectives for the students and reflects on what has happened and whether the expectations and objectives were met.

The sitemap section is a graphic overview of the program's overall organizations. Users can click on any item to directly navigate to a particular content area they want to jump. The Help section provides users with a brief overview of the interface of the math•ed•ology™ project and offers trouble-shooting advice. A chat section, which is online discussion forum, allows user to consult with experts and fellow teachers. A notes section provides users with an opportunity to record thoughts and ideas. It is recommended that users carefully consider each question and then open their favorite text editor (such as Microsoft Word™, WordPerfect™, Notepad, WinWord™, or SimpleText, etc.) and write down and save their comments there. A complete listing of NCTM Curriculum Standards and Professional Teaching Standards, and Bilingual resources are included for reference. An Assessment section allows the user to practice identifying curriculum strategies and identified language strategies, reflect and extend section on the lesson taught, and consider additional methodologies for teaching similar lessons. <Figure 1> shows the sitemap of math•ed•ology™.

FIGURE NOT AVAILABLE

<Figure 1> Sitemap of math•ed•ology™

3. Implementation of math•ed•ology™

The web browser has become a uniform interface for users to archive multimedia information over the internet. The convenient uniform user interfaces is a major characteristic of the web. To enhance the functionality of the web browser, it is definitely worthwhile to incorporate the visual programming into the browser. The visual programming tool and Frontpage Explorer & Editor are useful for this purpose in the project. Hence the system is developed as an embedded module to reproduce programs. Some multimedia data such as graphic, animation, video and music have inherent hierarchical structure[3]. Multi-structure information is useful for handling hypermedia documents[4]. Basic idea of dealing with thousands of audio and video icons for huge hypermedia system efficiently is that separating generic and specific audio and video files as a first step. The next step is making a basic template including all different types of generic text and image icons that specify image source, default hyperlink location for audio and video icons.

To make basic template program, we use FrontPage Explorer and JavaScript. On the top header frame file, we include main 11 section icons, Home, Sitemap, Introduction, Bilingual/ESL(English as a Second Language), Lessons, Help, Chat and Notes. Each icon has hyperlink so users can navigate any time they want to make jump. All different teacher's lesson contents are in the Lesson Section. From the Lesson, user can watch all twenty-five lessons' database. Each lesson has overview, part 1 through part 3, (some of the lessons have 2,4,5 or 6 lesson parts), and assessment. Make separate teacher's image folder to put all kinds of images which are graphics, classroom pan image, student work image and icon images. And also, make separate teacher's media folder to put all audio and video files.

The followings are the steps to prepare audio and video files. Take video camera for the real classroom teacher's lesson. From this analog tape, convert it to digital master tape using AVID and MC Express system software. And export video files to avi file format. Record all voice over of the teachers, mathematicians, mathematics educators, and language specialist's commentaries for the lessons. Digitize the audio and export to wav file format. Next step is using SoundForge to edit video and audio files. And save files as real audio and video(rm file type). To make animation files, which are in sub menu mathematical concepts on overview screen, we use 3D Studio Max.

At this point we need to think about reproduce the application with different contents and same types of basic template program. It is necessary for developers to operate multiple programs with same format on the network. An ideal reproduction system must allow the developers to manage huge size of programs as simple as possible. It is important not to change every file and every multimedia icon to reproduce the application. It is natural to build applications on the top of the web client to maintain the same interface platform. In order to use efficient way to reproduce same types of hypermedia system, it is recommended to take naming convention, and to make dummy(alias) media files which have only file pointers pointing the location where real audio and video files exist[10].

<Figure 2> shows the inherent hierarchical file structures to reduce efforts when we reproduce the same types of applications.

FIGURE NOT AVAILABLE

<Figure 2> File Structure of math•ed•ology™

The summary of developing stage in order to reproduce application program is as follows:

1) Separate files into general (generic) and specific audio. Media folder has plenty of audio and video files, including generic and specific files. Dummy media files have file pointers only. To reproduce new lesson, it needs to change the real audio and video files instead of changing whole html files, file properties and default locations of every audio and video icons. All audio and video icons have specific image properties from generic image folder in the template program.
2) Use the same naming convention to make file names for all audio and video data.
3) Make dummy audio and video filé, which has corresponding file pointers using same naming convention.
4) Change only real audio and video files in real media folder.

Developers do not have to change all image properties, audio properties, image source, or image location at all. Once change real audio and video files in media folder, that is all developers have to do reproduce multimedia application which has the same types of format.

4. Evaluation of math•ed•ology™

This self-evaluation of math•ed•ology™ is completed using Gagne's Nine Events of Instruction. It is based upon the survey result of graduate students and educational professional who reviewed math•ed•ology™ several times. math•ed•ology™ was reviewed from the teacher standpoint, and viewed as a teacher learning strategies to teach mathematics.

1) Informing the learner of the objective: The objectives can be found throughout the program. The focus questions help to bridge the user from learning to actually doing. The user can create their own lesson plan by following the focus questions. And also user-outcome section shows what the user will learn from this program.
2) Presenting the stimulus material: Through the use of video, it is possible to learn from some of the best teachers, and listen commentary from the experts from various fields. For the novice teacher can watch how the real classroom will it be and what will the student reaction be.
3) Providing learning guidance: math•ed•ology™ provides guidance through the use of real classroom video, transcripts, and all different kinds of commentaries for teachers that are learning to teaching methods and strategies. For the programming point of view, the sitemap section shows overall view of this program and every spot has hyperlink to corresponding pages, so users can navigate easily.
4) Eliciting performance: The focus questions are a way to elicit performance. The teachers are asked to start thinking about the materials and applying it to their work.
5) Providing feedback: There is no feedback. The program is interactive in the sense that user can push buttons to navigate as user chooses, but there is no real feedback given. Using chat section can solve this problem. The chat section is online discussion forum allows user to consult with experts and fellow teachers.
6) Assessing performance: The assessment is a good tool to see what the learner has learned. It is important to see what the user is able to identify from the lesson, reflect on, as well as extend the knowledge, and applying it. math•ed•ology™ provides the assessment section includes overview, identify, reflect, extend and apply[8].
7) Enhancing retention and transfer: The assessment provides a forum for students to plan different activities based on the information that they have learned. For the technical point of view, one lesson is completely programmed, then all twenty-five lessons programmed with same basic templates. It gives benefits and cost reduction to develop effort reduction to use the programs.
8) Stimulating the recall of pre required sites capabilities: Identified curriculum standards and discourse standards are given with complete lists of those. So user can refer to write new lessons. Users are asked to recall the section required in the assessment section.
9) Gaining the user attention: Overall, graphic icons, live classroom video, and animation are enough material gaining user attention[9].

Overall math•ed•ology™ gives most of the items needed except feedback section. The program does not evaluate the learner performance at the end, so the user does not know if the objectives were achieved and to what degree. There needs to be a component that will provide feedback to the user on how well s/he did.

5. Conclusion

The demand for development educational hypermedia system is remarkably increasing along with the developing time and cost because the size of multimedia resource files is huge. In this paper, I introduce math•ed•ology™ system from my efforts and experience when I worked on the project for developing the system. I propose a method, which supports not only dealing with a large number of multimedia files efficiently, but also reducing developing time in the same types of multimedia application programs. The main contribution of this paper is to propose the efficient method of programming for large educational hypermedia systems to reproduce using basic templates with naming conventions and alias (dummy) media files, which contain file pointers only. I present self-evaluation of math•ed•ology™ system, so other developers can refer to the view on the designing stage on their own.

The math•ed•ology™ system can be extended with new contents for middle school and high school mathematics education materials. A feedback section can also be added for future research to orient the user on the system's development stage.

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Teaching and Learning Operations Research with Interactive Applications

Stephan Kassanke
University of Paderborn, FB5, DS&OR Lab
Warburger Straße 100
33098 Paderborn
Germany
Phone: +49 5251 60 37 21 / Fax: +49 5251 60 35 42
E-mail: kass@uni-paderborn.de

Abstract: This article deals with the use of computer-aided tools for teaching Operations Research/Management Science. We describe two of them, ORWelt and ClipMOPS, and show how we use them for teaching purposes. ORWelt is a hypermedia learning environment covering the subject area of Operations Research on an introductory level. ClipMOPS is a dedicated tool for modeling and solving optimization problems. Students can use these tools in addition to the lecture. The long-term goal is to change the way of teaching towards application-oriented learning while basic content can be learned with ORWelt and ClipMOPS.

Introduction

In this paper, we discuss approaches of learning the interdisciplinary subject area of Management Science/Operations Research. Management Science (MS) is closely related to Operations Research (OR) and summarizes the application of the modeling approach for managerial decision support. The objective of OR is to find practical solutions to operational problems of all kinds, often within tight time constraints. The models are usually built using quantitative methods, such as linear programming, mixed-integer programming, network models, decision analysis, discrete and continuous simulation, queuing models, and so on. OR methods often facilitate an in-depth understanding of the problem.

Operations Research (OR) is a very complex subject matter to teach. As indicated above, a wide range of quantitative methods is applied to practical problems. Typically, realistic problems are often unstructured, it is not obvious at first glance which method is appropriate. Students learning the subject matter are not perfectly prepared to handle the complicated, often messy problem situations. The usual teaching methods such as lectures are not suited to transfer the problem context beside teaching basic algorithms. Moreover, the traditional, method focused way of teaching management science does not leave much time for case studies, discussions, and student presentations in classroom.

The ability to apply mathematical modeling techniques can be trained with case studies. Then methods are bound to a situated context and students have to analyze the problem and find out which method should be applied in which way. This requires far more elaboration than merely applying a given algorithm on a clearly defined problem. In our point of view, learning emerges from an active construction process and knowledge must be integrated in the learner's mental models to make it accessible in the long run. This process can be supported by situated learning, e.g. by discussing case studies. Moreover, situated learning is more fun, thus increasing students' motivation to learn because they can feel an immediate success after constructing a solution themselves. In most cases it is not possible to present rich case studies in a lecture due to time limits. Furthermore, because there are often more than one hundred students with varying backgrounds and interests (majoring in business studies, business computing, industrial engineering, computer science, or business education) in a university class, it is not possible to adjust the pace so that each student can easily follow a teacher-centered lecture.

These were the reasons why we decided to provide students with a tool which helps them to learn quantitative methods also outside the classroom at their own pace, thus leaving more time for discussions, presentations and teamwork during the classes. We believe that an interactive, computer based tool is better suited to achieve this goal than a conventional textbook.

Our thesis is that traditional lectures can be enhanced but not substituted by computer aided tools. In the subsequent sections of this paper we present two approaches on how this can be done. First we introduce the hypermedia learning environment ORWelt, second the specialized tool ClipMOPS which serves as a modeling tool for optimization models.

ORWelt

The ORWelt project started in February 1996 with the intent of providing a hypermedia learning system that would cover all standard introductory OR material, supplemented by tests. Furthermore, case studies were provided in order to support different approaches to the same content. The purpose of ORWelt is not to replace the lecture but to give the lecturer more time to discuss real-world case studies with the students. We do not expect that computer based learning approaches will replace face-to-face communication in real-time between students and lecturer. The personal contact between teacher and student is still important because goals such as motivating students for the subject matter, i.e., providing input which affects the student in a positive manner, can hardly be achieved by a computer-based system alone.

Currently, ORWelt comprises 19 subject and 15 test modules covering the main subject areas of MS/OR on an introductory level. Content can be directly accessed through a graphical browser or the learner can visit a predefined guided tour. Besides standard navigational tools such as footprints, bookmarks and history, guided tours can be defined in order to avoid the 'lost in hyperspace' effect. The contents covered by ORWelt are shown in (Fig. 1). Shadowed nodes labeled in italics denote subject modules supplemented with test modules. In addition to the subject modules, ORWelt includes test components to allow students a self-assessment of their comprehension. The tests are usually not multiple choice, but a wide range of interactive methods is used in order to allow the exploration of the test. Our goal is that students get engaged in learning instead of merely receiving information.

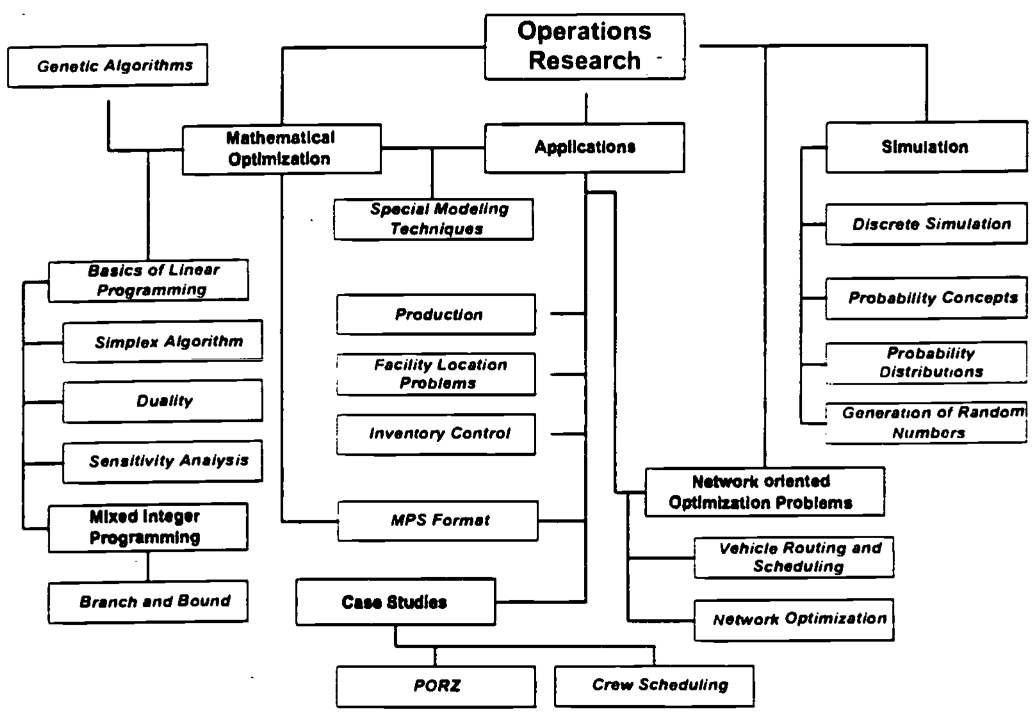

Figure 1: Content covered by ORWelt

A key feature of ORWelt is the integration of the professional optimization code *MOPS* ® (*M*athematical *OP*timization *S*ystem, see (Suhl 1994)). MOPS is an all purpose optimization code library which can be accessed from many programming environments, on condition that Windows Dynamic Link Libraries (DLL) are supported. The utilization of MOPS allows the user to solve predefined optimization models while varying parameters of the model. The solver itself resides in the background, and the output has not necessarily to be formatted as a tabular report. It is left up to the developer how to visualize the results. Most optimization models in ORWelt visualize the resulting solution graphically, for example using pie charts, indicating a way to interpret the solution. It is important to direct the learner's attention to the critical point of the solution shown. Empirical studies in the field of illustrations indicate that general instructions to pay attention to a specific illustration are ineffective, the learner needs calculated hints pointing out the important aspects (see (Weidenmann 1997)). Transferred to the field of OR, graphical visualization offers much more possibilities to direct the learner's attention into a certain direction than a simple tabular report. This way OR concepts such as sensitivity analysis can be explored in a very vivid way. 'Dynamic' optimization models which can be solved on the fly by MOPS add a new quality of learning and teaching that cannot be achieved by means of a normal textbook. The dynamic representation allows the learner to interact with the model: he or she can alter parameters, compare solutions and explore the structure of the problem formulation.

The project ORWelt started with an experimental phase followed by iterative refinements of the development process. We use teams of typically 2-3 students attending a project seminar with a total of 2-6 groups per semester. The seminar is supported by a group of two knowledge domain specialists and one or two programming specialists. The authoring environment we use is Asymetrix Toolbook®, currently version 6.1 (Instructor II). Writing hypertext is not intuitive and requires certain skills in structuring information. On the one hand, it is quite demanding for students to develop educational material while, on the other hand, they get a very valuable experience out of it. Intensive coaching of students is necessary but it is possible to achieve high quality software. See (Blumstengel, Kassanke 1998) for a detailed description of the development model.

At the moment, ORWelt is a supplementary offer for students, they can use it but they do not have to. The long-term goal of the ORWelt project is to change the way of teaching towards application-oriented learning (Blumstengel, Kassanke, Suhl 1997). Lecture time should be used more efficiently to discuss real-world problems while teams of students learn parts of the material, especially basic algorithms, supported by the learning environment. ORWelt can also be used as a reference and for exam preparation. For a more detailed description of ORWelt see (Blumstengel 1998). ORWelt can be downloaded at (ORWelt 1999).

The optimization code MOPS is also used in the next example 'ClipMOPS'. In ORWelt, students have the possibility to solve optimization models in the so called MPS format. Students can use ORWelt as a tool to solve self formulated models without having to worry about formulation syntax of other solvers because the MPS format is an industry standard for optimization models. Although they can solve these models using MOPS, the model representation is not interactive in the sense of direct manipulation. Modifying a single coefficient requires altering the MPS file and reloading it. In ORWelt it was not possible to provide an interactive model representation due to technical restrictions of Toolbook. The second tool discussed here is dedicated to modeling purposes.

ClipMOPS

ClipMOPS was developed in close cooperation with the Free University of Berlin in 1998. ClipMOPS is intended as a students' tool for modeling optimization models and was introduced to students in Berlin and Paderborn in the winter term 1998/99 for the first time.

Traditional optimization software is typically run by a cryptic command language. Students cannot fully concentrate on the real task (modeling an optimization problem) but have to cope with learning a specific command language. Graphical user interfaces are not very common in this field of software and an easy-to-use software was not available. Currently we use two software packages – AMPL® and LINDO® – in teaching OR. Both are based on the DOS/Windows operating system and have few graphical visualization abilities. Furthermore, AMPL is a powerful but not easily mastered modeling language. AMPL is not a beginner's tool, the learner has to have a clear understanding of the model's structure. The problem is that we teach a broad variety of students majoring in diverse studies. They usually have problems to use the optimization software currently used due to their different mathematical background and algorithmic training. Although, the Microsoft Excel® solver add-in solves optimization models, it has some drawbacks. Namely defining models with the solver add-in is not very intuitive and, more important, the resulting solutions provided by Excel's solver are not necessarily reliable (in the case of mixed integer programs and degenerate solutions, see (Thiriez 1998)).

We wanted a tool which encapsulates the formal description of an optimization model in a graphical, intuitive way and additionally offers reliable solutions. Due to these reasons we considered a spreadsheet platform to be ideal for our purposes. At this point, we started to develop a solution ourselves with Excel in combination with MOPS. Excel is very common, most of our students use the Microsoft Office suite for word processing etc., thus students have a basic understanding of how to operate Excel in general (e.g. cell editing). Furthermore Excel meets the technical requirements for using MOPS (linking Windows DLLs).

Optimization models can be represented in a two-dimensional matrix of decision variables and restrictions. This matrix can be directly transformed to a spreadsheet representation of columns and rows where columns represent decision variables and rows are shown as constraints. Although this way of defining a model is only appropriate for small scale models and does not reveal the model's structure, students seem to prefer this representation (see (Fig. 2)). Especially beginners favor a matrix representation to the very compact mathematical formulation or a model definition in the MPS format, respectively.

	B	C	D	E	F	G	H
2	Diet	CHOCO	ICE	LEMO	CAKE	***TYP***	***RHS***
3	***MIN***	2	1,5	1	3		
4	***LB***						
5	***UB***	INF	INF	INF	INF		
6	***TYP***	CON	CON	CON	CON		
7	JOULE	700	800	250	900	>=	2000
8	CACAO	50	30			>=	100
9	SUGAR	30	30	60	60	>=	150
10	FAT	30	60		75	>=	120
11							
12	**Activity**	1,14	1,43	1,21	0,00		5,64

Figure 2: ClipMOPS model representation of the diet problem in Microsoft Excel

ClipMOPS has an easy-to-use interface and allows an iterative refinement of optimization models. This way students can concentrate on modeling the optimization problem and waste no time to figure out how to tell the system what they want to express. The model size is restricted to a maximum of 100 decision variables and 200 restrictions but this model size is sufficient for teaching purposes. Existing models in the standardized MPS format can be imported and exported. Additionally the seamless integration into the Excel environment allows to make use of Excel's built-in graphical abilities. A student version of ClipMOPS can be downloaded at (ClipMOPS 1998).

Using ORWelt and ClipMOPS for Teaching

ORWelt and ClipMOPS may be used by students and teachers, as well. As a teaching resource ORWelt may be used by the lecturer as a high-level visualization tool, e.g., to visualize algorithms stepwise and to give further explanations on each step. This way he or she can attract the students' attention to crucial points in the animation. Algorithms are dynamic while the traditional methods used to teach them are not. An animation accompanied by a lecturer's comments fits the dynamic nature of an algorithm much better and adds a presentation quality which normally cannot be achieved by traditional means. Although developing multimedia animations is expensive, the development effort for additional animations decreases, since ORWelt contains a set of all purpose animation routines which is permanently enhanced and can be used repeatedly. The presentation of case studies can be enriched by sounds, photos, videos, etc., thus giving a more vivid impression on what the case study is dealing with. Students are not just passively receiving but actively constructing a solution themselves. As a hypermedia environment ORWelt integrates all types of media in one environment, a laptop and a projection device such as a video beamer or LCD panel are sufficient. Additionally, the hypermedia structure fits the manifold relations between different concerned subject areas better than a linear one.

Students profit from the benefits of self-directed learning as well. They can choose the location (where), time (when), and duration (how long) they spend with the learning environment, that means the availability of the learning environment is enhanced, there are no fixed times or locations for learning. However, to accomplish the engagement of students in the learning environment, a simple transformation of a book to a linear, electronic form is not sufficient. To achieve this goal, one has to use interactive elements, e.g., simulations or dynamic optimization models, in the learning environment. The degree of interactivity is a crucial factor for the success of a hypermedia learning environment (see (Haack 1997, p. 152, Schulmeister 1996, p. 388ff)). Preliminary questionnaire results indicate that students consider interactivity, animations and tests to be the most important advantages of ORWelt compared to traditional education material.

There is no comfortable way to define optimization models within ORWelt (except MPS files), this gap is filled by ClipMOPS. We consider ClipMOPS as a high-level tool which should be used in a way similar to a calculator. Our students are required to gain modeling skills, the final calculations can be done by optimization software. Although it is important to know how optimization models can be solved without the help of computers, no one will try to solve a problem of realistic size without optimization software due to the amount and complexity of the necessary calculations. The computer is an authentic tool and should already be used during students' education.

ORWelt and ClipMOPS will be extensively employed for teaching purposes in the future. Both tools have reached a reliable degree of stability and will be permanently improved. We intend to add a world wide web (WWW) based component to ORWelt, thus enabling learners to access it over the internet. The long term goal is to change the way of teaching towards application-oriented learning in the lecture while basic content can be learned with support from ORWelt. Our Students need OR modeling skills to tackle the problems of the future. ORWelt and ClipMOPS are two examples how we try to improve the quality of teaching OR.

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Animations in Physics Educational Software

Richard R. Silbar, William C. Mead, and Robert A. Williams
WhistleSoft, Inc., 168 Dos Brazos, Los Alamos, NM 87544, USA
E-mail: silbar@whistlesoft.com

Abstract: In the process of learning how to create effective computer-based training modules for accelerator physics, we have come to believe that simple two- and three-dimensional animations are often the most valuable multimedia tool for presenting technical material. This talk demonstrates a number of the animations we have developed for our tutorial series *Accelerators and Beams* and discusses why we think they are successful. Examples range from illustration of the right-hand rule for vector cross products to demonstration of the so-called "vertical betatron oscillation" that is used for ensuring stable beams in accelerators.

Introduction

Four years ago WhistleSoft, Inc., began developing a set of computer-based multimedia tutorials for accelerator physics under a Small Business Innovation Research grant from the U.S. Department of Energy. At the time we began this project our expertise was not in multimedia but in science. Company personnel consists mainly of Ph.D. scientists who were at one time associated with the Los Alamos National Laboratory. We considered ourselves as domain experts in the subjects for which we were about to develop tutorials. On the other hand, we had a lot to learn about user interface issues and how to create multimedia. Even more important, we also had much to learn about instructional design and pedagogy.

We originally designed the *Accelerators and Beams* tutorials for the academic market.[1] However, we have always had the idea in mind that we could later customize its separate modules for laboratory and/or industrial usage. This would extend the use of these modules to a non-traditional student audience, such as the technicians and operators employed at large accelerator facilities. We are therefore targeting a broad audience – from lower undergraduates and technicians up to graduate students and professionals in science and engineering. Most of our work so far, however, has been at an elementary level, for end users who have taken, say, an algebra- or calculus- based introductory physics course.

The modules comprising *Accelerators and Beams* use all the usual multimedia techniques: interactive On-Screen Laboratories,™ hypertext, line drawings, photographs, two- and three-dimensional animations, progressive disclosure (at the student's choice of pace), and video and sound. The multimedia enhances the student's rate of learning and length of retention of the material.

This paper discusses what we have found to be arguably the *most* effective multimedia technique for learning physical concepts: two- and three-dimensional animations.

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[1] Our publisher, Physics Academic Software (see http://www.aip.org/pas) released *Vectors*, late in 1997. The *Forces* module became available in August of 1998. *Motion in Electromagnetic Fields* recently began shipping, and PAS has also accepted *Dipole Magnets* for publication. We expect to publish two other modules in this series.

The Textbook Approach

A typical modern physics textbook contains many figures and pictures. The diagrams are almost always two-dimensional and static.

There are a few exceptions. Some textbooks, such as the classic text on mathematical methods by Morse and Feshbach, have experimented with doubled, offset pictures which, when viewed with special glasses, give a three-dimensional "depth" to the drawing. Others, such as Max Born's *Restless Universe*, give crude animations by utilizing an old "flip book" technique predating even Walt Disney's cartoons.

These exceptions, however, are quite rare, despite the fact that many concepts in physics involve both motion and all three spatial dimensions. We suspect that one reason why there are fewer physics majors than, say, psychology majors is this: there is a particular aptitude that only a few people have for being able to visualize motions and depth from the two-dimensional figures the texts and lecturers can present.

We also suspect that the non-traditional student, such as the accelerator technicians we are also targeting, have a much more "hands on" approach to learning. Two-dimensional diagrams, while a staple of their trade, are probably secondary to their understanding of a circuit or a device.

The Computer Advantage

A computer-based tutorial is *not* a substitute for a good textbook. It is hard to read extended text on a computer screen. However, the personal computer has many advantages over a textbook, one of which is that it can easily present a moving picture of a three-dimensional concept.

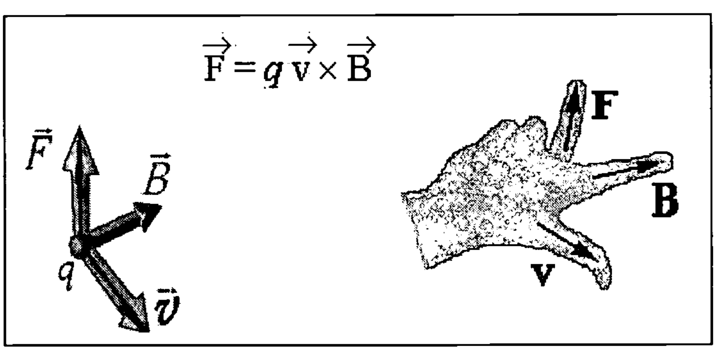
In what follows, we will discuss some of the example animations we have incorporated in our tutorials. The reader should bear in mind that this abstract is just like a textbook, namely static and two-dimensional. We will try to impart the flavor of the animations, but there is no substitute for seeing them "live" on a screen. The presentation of this paper will demonstrate these animations, projected from the computer.

Most of the examples we will show below are three-dimensional animations dealing with concepts involving electromagnetic forces. That is because of the nature of the main theme of our modules, *Accelerators and Beams*, where the electromagnetic force is the important one. We believe that similarly effective animations would be helpful in many other core physics courses, such as classical and quantum mechanics.

Animation Examples

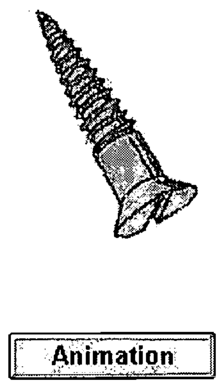
Right-Hand Rule

An important (and often difficult) concept for many students is to understand the direction of the force felt by a charged particle moving in a magnetic field. This Lorentz Force is expressed as a vector cross product of the particle's velocity with the magnetic field vector, as in the following:



This figure is a snapshot of a portion of a page from our *Vectors* module. The equation and the photo of the hand are static. The colored arrows at the left, however, are shown as they appear in the last frame of an animation which shows how one "swings" the velocity vector **v** into the magnetic field vector **B** to get the force direction. This is then followed by a moving camera view of the three vectors that shows them from a number of points of view, ending up in the position shown. The student can repeat the animation as often as he or she needs by clicking on a button labeled "Animation."

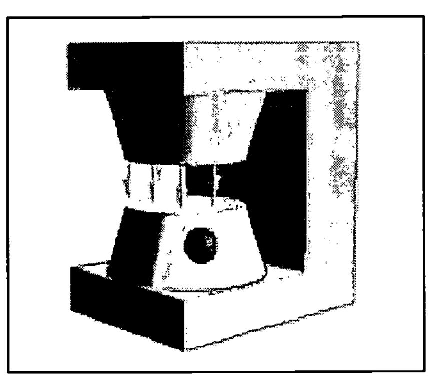
Another, related animation in the *Vectors* module shows the motion of a right-handed screw, a concept difficult to describe in words or in static pictures.



The page on which this animation occurs first shows the (static) picture of the wood screw shown on the left. When the student clicks on the animation button, the screw is replaced by the corkscrew-like spring that then rotates and winds its way up from the lower right to the final position shown.

Bending Magnet

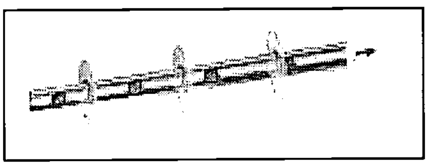
The concept of motion of a charged particle moving through a bending magnet is a direct consequence of the Lorentz Force Law illustrated above. An animation showing this is represented by the following:

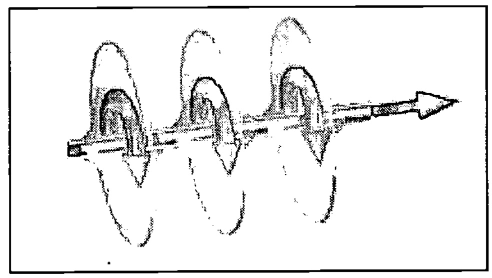


Here we see the animation in its initial frame. When the student clicks the button, the red ball (representing a charged particle) moves into the magnetic field of the dipole magnet and bends to the left. Again the student can repeat the animation as often as necessary. One reason why that might be necessary is that, in this case, our tutorial poses a question to the student: is the red ball negatively or positively charged? (You can figure it out from the right-hand rule.)

Magnetic Field Around a Wire

The *Forces* module also illustrates how a current-carrying wire builds up a surrounding magnetic field. The following shows the animation associated with this a few frames after its start.

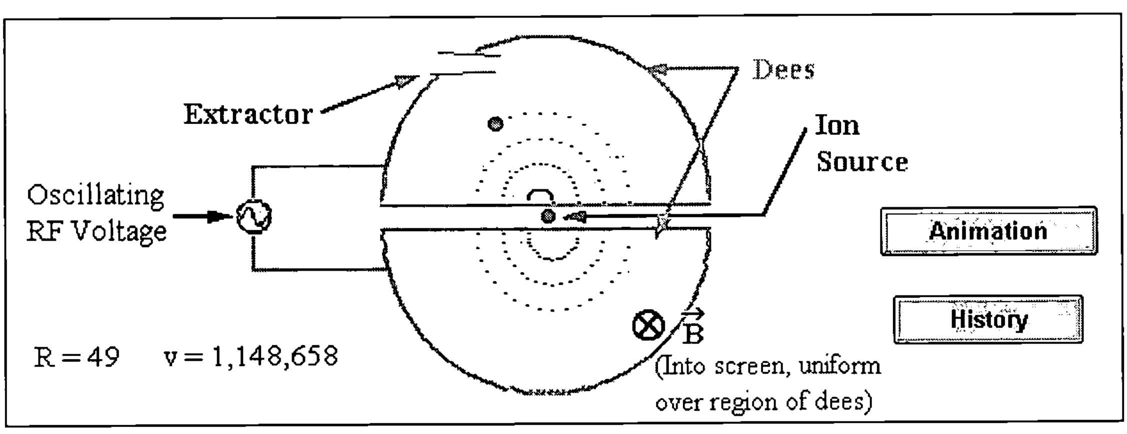




Here the "red charges" start moving through the wire to the right (as shown on the left), building up the blue magnetic field lines looping around the current. When the current reaches a steady state, the magnetic field stops growing, i.e., reaches its steady-state condition shown on the right. As usual, the animation is repeatable, as necessary.

Cyclotron

Our *Motion in Electromagnetic Fields* module contains a section on cyclotrons. The "How It Works" page has a useful two-dimensional animation, shown on the next page. Here the screen snapshot shows the situation partway through the animation. You can "see" the acceleration, which occurs, across the gap between the Dees from the spacing of the dots (and the increasing speed of the red charged dot). The display continuously updates the values of the radius of the arc and its (increasing) velocity at the lower left as the particle advances outward.

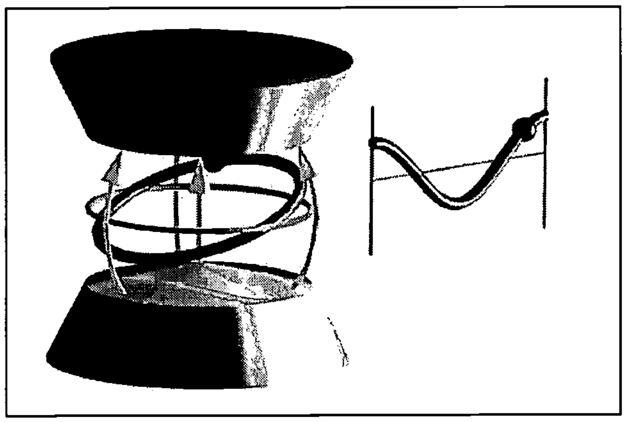


Eventually, the particle radius grows to the point where it leaves the upper cyclotron Dee through the extractor port. For the physicists among us, the resulting particle beam then can be used for a scattering experiment or production of a radiopharmaceutical isotope.

This two-dimensional animation, by the way, was done entirely within the authoring framework we use for our tutorials. We use a built-in scripting language to move the red charge dot and to leave its trace.

Vertical Betatron Oscillation

Moving on to a somewhat more advanced module, the *Dipole Magnets* tutorial discusses how these magnets bend and focus charged-particle beams. One of the topics considered is betatron oscillation, the use of restoring forces to keep the beam within the accelerator while it is being accelerated to its final energy. The animation for the vertical case looks like this:



The student is most likely to see this perspective-view animation after having first viewed a two-dimensional animation and another three-dimensional animation looking at the motion from the side. The green circle represents the "reference trajectory" and the red circle that of the red particle which is slightly "off" that principal path. The restoring force that keeps the red particle moving along the canted red circular path comes from the non-uniform-magnetic field. (The pole piece shaping, which makes the non-uniformity, is better seen in the side-view animation.) The moving red charge (ball) also simultaneously traces out the sine wave graph shown on the right side of the figure.

Lessons Learned

We began the *Accelerators and Beams* project without much appreciation of the power of a good three-dimension animation. Clearly, the more we learned about how to make them, the more we came to appreciate their pedagogical value. As we stated in the introduction, we believe that, for many purposes, this is the most valuable multimedia tool for presenting technical material.

Acknowledgments

We prepared the three-dimensional animations discussed in this paper using Macromedia's Extreme 3D and Calgary's TrueSpace applications. The animations are embedded in tutorials created using Macro Authorware. We want to acknowledge support for this project from the Department of Energy. We also thank Prof. John S. Risley, editor of Physics Academic Software, for his continuing advice and criticism of our software modules. Further information about this project can be found at http://www.whistlesoft.com/~silbar/. In particular one can download a white paper from there detailing the latest status of the *Accelerators and Beams* project.

Using Learning Protocols to Structure Computer-Supported Cooperative Learning

Martin Wessner, Hans-Rüdiger Pfister & Yongwu Miao
GMD - German National Research Center for Information Technology
Integrated Publication and Information Systems Institute (IPSI)
Dolivostr. 15, D-64293 Darmstadt, Germany, E-Mail: {wessner, pfister, miao}@darmstadt.gmd.de

Abstract: A common problem of CSCL (Computer-Supported Cooperative Learning) is addressed: How can we coordinate goal-directed, effective interaction in a group of learners? We introduce the concept of *learning protocols* which originates in script theory. We then discuss which dimensions of cooperative learning can be supported by learning protocols and propose how learning protocols can be integrated in a CSCL environment.

1. Introduction

Consider the following two examples:

- A trainer asks his/her students a question. After some seconds without response he thinks that nobody understood or could answer the question and re-phrases his question. Increasing the time between the question and the intervention by a few seconds has several positive quantitative and qualitative effects on students' answers [Rowe 1974].
- A group of learners is discussing a concept introduced in a presentation. The most eloquent and extrovert students dominate the discussion. Ideas and arguments of others remain unheard. Providing a set of rules which enable everybody to participate, and structuring the discussion as a cooperative process can guide the interaction in discussions and improve the learning process [Hall & Mancini 1997].

These examples indicate that learning can be improved by defining certain constraints and by structuring the learning process. Our work deals with the question: How can such constraints, rules, or process structuring methods be realized in a computer-supported cooperative learning environment? We call this kind of integrated learning support „learning protocols".

We see several developments which lead to the need for learning protocols. During the last decades learning is regarded more and more important due to the increasing amount of knowledge available world-wide, the increasing complexity of knowledge, and the increasing speed of these changes. This raises demands to establish a new learning culture: (1) Learning has to be a life-long process, we have to better *support adult learners* whose learning processes differ in many ways from those in schools or universities. (2) Individual learning methods are not sufficient for mastering the complexity of knowledge, we have to provide methods and *support for groups of learners* to cooperatively acquire knowledge and transfer it to daily practise. (3) In order to address changes in work organization as well as in society in general, learning cannot be limited to scheduled activities in a common classroom. Learning has to be *flexible over various dimensions* such as time and space. Therefore we need learning environments which support different learning scenarios, e.g. asynchronous learning or learning by geographically distributed learning teams. Our focus is on distributed cooperative settings, in which learning teams of adults want to learn in a flexible way.

Focussing on *co-located and synchronous* settings, a number of field studies have indicated that students can learn effectively in pairs and in small groups, if they are supported by appropriate learning methods [Slavin 1995]. Cooperative learning can improve several cognitive and social aspects of the learning process [Mancini et al. 1998]. In a *distributed* cooperative setting, learning teams need means to communicate and to coordinate their learning activities. Given an infrastructure with networked computers, communication and cooperation environments which address these needs, e.g. by providing various communication channels and shared data repositories, are available (e.g., Microsoft NetMeeting). Can cooperative learning also be used in a distributed cooperative setting in order to achieve similiar positive results as in a traditional setting? Can we transfer the cooperative learning methods?

These topics are tackled by a field of research called computer-supported cooperative learning (CSCL) [Koschmann 1996]. Some positive experiences have been made using computers to support cooperative learning in traditional settings. For example, in the CSILE system a certain cooperative learning method is modelled, and learners are guided through the process by specific rules [Scardamalia & Bereiter 1996]. In [Hron et al. 1997] a system was successfully tested that controlled the dialog in cooperative dyads with a specific communication interface.

There are some additional constraints in a distributed cooperative setting: The quantity and quality of transmitted information is different because many non-verbal signals are not transmitted. E.g., chat and e-mail deal with written communication and provide only limited support for non-verbal communication by using emoticons or attaching sound or image files to a message. Audio/video conferences provide audio-visual information in a lower quantity and quality than face-to-face settings. A major problem is that some cues are missing which structure cooperative learning in the co-located, synchronous setting. As a result, e.g. simple turn taking mechanisms in discussions fail in such settings.

We see two ways to address this issue:

- Integrate nonverbal signals in a CSCL environment by integrating additional communication channels, e.g. sensors detecting whether the learner is currently present in front of the computer or cameras analyzing facial expressions.
- A second way is to develop cooperative learning methods or adapt existing ones to the distributed cooperative setting, and thereby taking into account the constraints of this setting such as changed number and quality of communication channels or less ambient information flow.

The first solution leads to systems which track and check user activities with various kinds of sensors. That can be in the way of virtual reality as immersive 3-dimensional virtual worlds or by enhancing the intelligence of rooms and furniture in the real world. The advantage of these approaches is to represent reality and thereby providing a familiar environment with well-known or easy-to-learn means of communication and cooperation. But this advantage holds only as long as the system more or less clings to reproducing reality; additional support provided by the system has to be learned by the users. Our approach, however, is related to the second solution. We call cooperative learning methods in a distributed setting *learning protocols.*

The remainder of this paper is organized as follows: In the next section the concept of learning protocols is described in more detail. Section three elaborates on the various ways in which learning protocols can help teams of learners to improve their learning process and results. The integration of learning protocols in a CSCL environment is presented in the fourth section. We close with a description of our next steps.

2. Learning Protocols as Implemented Scripts

In cooperative learning we distinguish two kinds of supporting methods [Hron et al. 1997, Mancini et al. 1998]:

- Global methods which structure the cooperation on a general level, e.g. by providing support for group organization, monitoring constraints such as a maximum floor holding time.
- Structured or scripted cooperative learning methods which provide protocols for cooperative learning by structuring the dialog and actions of the learners.

Learning protocols perceived as scripted cooperative learning methods are theoretically based on psychological script theory. In cognitive and social psychology, generalised knowledge about a routine sequence of related events and activities is commonly called a script [Schank 1982], [Schank & Abelson 1977]. A script is a knowledge structure that, once activated, yields information on what events to expect and how to act in a specific type of situation. For example, the well known restaurant script describes the sequence of actions when having a meal in a restaurant (e.g., ordering, eating, paying), and it specifies what to expect from others, e.g., from the waiter, depending on one's own actions. A script can be seen as a type of schema, which, in addition to a prototypical chain of actions, contains slots to specify the temporary circumstances, and default values to guide expectations and inferences if no further information is available. Hence, scripts not only control many stereotyped encounters of daily life, they also reduce cognitive effort by providing guidelines that decrease the need to think about one's actions in well known situations.

Scripts can be triggered by aspects of the situation (situation-controlled script; e.g. initiating a vote in a controversial discussion) or by a specific role (role-controlled script; e.g. a trainer is expected to answer a question and to determine the learning process). To act according to a script one has to know the script itself and one's part in that script. The activation of a script is considered to be mostly automatic.

Cooperative learning methods can be perceived as externalized scripts attached to learning situations or roles in a learning team. In natural face-to-face situations, the actions of persons applying the same script are aligned by a lot of explicit and implicit cues (e.g., non-verbal cues such as pauses or changes in posture indicate turn-taking in a discussion script). In computer-mediated learning environments, however, these cues are largely missing, and the coordinated enactment of a script can be seriously endangered. Especially, cooperating learners may not use the same script at all, or may be uncertain about which script the others apply, or may define their roles in the script differently, or may loose orientation where the group currently is in the script. These difficulties in CSCL environments suggest that one should not rely on an automatic script enactment, but that one should provide scripts as implemented procedures that can be executed on demand. Learning protocols, as defined here, are just a set of useful scripts for learning, externalized as executable methods, with roles, events, and actions made explicit.

3. How Learning Protocols Can Structure Cooperative Learning

3.1 Explaining: An Example of a Learning Protocol

Imagine that in a pairwise learning situation person A needs an explanation about some problem. Hence, he asks for explanation from person B, who tries to provide the explanation. In natural face-to-face situations, all interactions during the explanation process are usually carried out without much friction, since many verbal and non-verbal cues guide the dialog. However, in a distributed computer mediated situation, person A might want to activate an "explanation protocol", which then controls the communication process. The explanation protocol is very simple, basically controlling the right to speak and indicating which type of communication is currently being performed (if, e.g., a question is asked, or if an explanation is delivered). The protocol will, for example, strictly switch between explainer and explainee. The explainee will respond to an explanation either by asking for more information, or by deciding that he is satisfied with the explanation, which will terminate the protocol. The explainer will either deliver a further explanation, or he will declare himself unable to provide the explanation, which will also terminate the protocol. Learning protocols can be represented as a kind of state-transition-diagram; Figure 1 gives an example. The following sections show that this very simple learning protocol can be enhanced by integrating control over other ressources such as learning artifacts and shared workspaces.

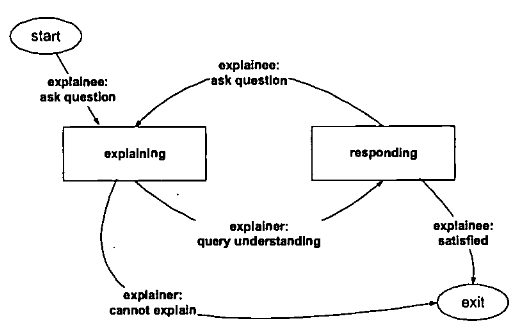


Figure 1: State-transition-diagram of an explanation protocol

3.2 Levels of Learning Protocols

Learning protocols are useful on different levels of the cooperative learning process:

- On the most basic level, they guide elementary communication processes among learners, e.g., discussions (be it by audio or chat), presentations, or dyadic dialog.
- On the next level, protocols support group activities which need some coordination control, e.g., common navigation through hypermedia documents or preparation of agendas and time schedules.
- The third level refers to protocols which are designed to support cooperation, e.g. jointly editing, domain specific role plays or simulations.

On each level protocols range from more generic collaboration protocols, such as a discussion protocol, to very learning specific protocols, such as giving an explanation in a certain domain. In principle, the list of potential candidates of cooperative learning processes that could be translated into learning protocols is almost infinite. Special techniques such as "Jigsaw II" [Slavin 1995], or different cooperation modes such as symmetrical (e.g., a discussion among students) and asymmetrical (e.g. a presentation) modes, depending on role and group structure, could be devised.

We think of learning protocols as a set of potential support tools from which learners and trainers may select what they consider to be useful. At any time, participants may choose from a menu a specific protocol, which is then activated. When finished, the group is free to select any other protocol, or to proceed without systematic support. Hence, the overall learning process is not itself controlled by a protocol, but can be augmented at any time when support seems appropriate.

3.3 Components of a Learning Protocol

Irrespective of the level of a protocol, a protocol consists of a set of components, which can be derived from script theory. First, a protocol has a name; the name signifies the situation type to which the protocol can be applied. For example, a (cooperative) explanation protocol applies to situations in which an explanation is needed by some person and can be delivered by some other person. Unlike in natural situations, learning protocols are selected solely by name, i.e., a person subsumes the situation under the category referred to by the protocol's name, and intentionally activates the protocol.

Secondly, a protocol consists of a set of states and transitions. In each state the users can perform actions such as communicate or manipulate artifacts. A transition to another state is triggered by an action or a specific condition, e.g., the time-out of the preceeding state. Of course, various iterations and conditional branchings may occur. The interface of the learning protocol has to take care that different types of actions are appropriately perceived and classified.

Thirdly, a protocol includes different roles pertaining to the persons involved in the enactment of the protocol. A learning process commonly consists of one or more students, and one or more trainers or teachers. Other roles specific to learning are tutors, experts, and moderators. Each participant of a running learning protocol needs to obtain a definite and unique role, and needs to know which roles other participants have. The role one has is either arbitrarily defined by oneself, or is derived from the overall group structure. Roles should also be indicated on the computer screen, i.e., everybody should be informed about his and the others' roles by some sort of visual indicator, in order to prevent role confusion.

Finally, a protocol may contain various types of artifacts, i.e., text documents, graphical objects, test forms, etc. In many simple communication protocols, however, the definition of special artifacts is unnecessary, or only optional. For example, in the course of an explanation, the explainer and the explainee may use a shared whiteboard to outline some ideas, but this is not essential for the explanation process.

3.4 The Construction of Shared Knowledge

A special problem in cooperative learning is to gain a common understanding of the shared knowledge of the group. Efficient communication requires that each participant knows, at least approximately, what the other participants know. Without this common background, it would require a lot of time and effort to achieve effective cooperation. In cooperative learning, due to the continuous acquisition of new knowledge of each participant, the shared knowledge is ever changing. This makes it even more important to provide systematic support to construct and represent the common knowledge of the learning group in some way.

We propose that learners externalize their knowledge in the form of a diagram with nodes and links: nodes denote specific concepts (from the domain to be learned), and links denote specific relations among concepts, such as "is-example-of", or "is-subtopic-of". Without going into detail (see [Pfister et al. 1999]), it seems clear that this diagram of shared knowledge needs to be modified or updated regularly and systematically. A special type of learning protocol is needed to support the maintenance of the shared knowledge, providing protocols for expanding, for reducing, for restructuring the knowledge corpus, and for establishing consensus among learners on when and how to introduce changes to the knowledge.

4. Implementation

In the CLear (computer-supported cooperative learning) project at GMD-IPSI, we develop computer-supported cooperative learning environments and cooperative learning methods for such systems.

In a first step we designed the VITAL (=virtual teaching and learning) prototype using the COAST [Schuckmann et al. 1996] framework for building groupware. As described in section 2, we distinguish two kinds of supporting methods for cooperative learning: global methods and scripted cooperative learning methods. In VITAL we focussed mainly on supporting global methods. The prototype offers global group organization methods and a limited cooperation support, e.g. by providing a structured communication board and different cooperation modes. Evaluations of VITAL in university settings showed that the system is well accepted but offers only limited support for structuring the cooperative learning process [Beck-Wilson in press]. Therefore we extended the approach and integrated learning protocols [Pfister et al. 1998].

Our approach can be briefly characterized by (1) providing a virtual learning world consisting of different types of virtual rooms, in which learners can communicate and cooperate synchronously and asynchronously, (2) supplying each virtual learning room with a shared hypermedia workspace, (3) using hypermedia to represent the learning material, and (4) using hypermedia to define learning protocols and visualize their execution.

For implementing learning protocols in a CSCL environment we use several techniques:

- Some global methods can rely on access rights, rules and conditions, or mechanisms for conflict resolution. Therefore, we need functionality for defining and checking these methods.
- Scripted cooperative learning methods are modelled using collaboration protocols similar to state transition diagrams (see Figure 1). Each state is defined by specific functionalities and rights of the involved participants, i.e., a set of behavior rules, which define which role is allowed to perform which operation on which resource. The learning protocols are implemented using the modelling method of SCOPE, a system which allows the definition, execution, modification and monitoring of general collaboration protocols [Miao & Haake 1998].

The implementation provides guided interactions between the system and the users. Depending on the kind of learning protocol and his/her role a user may initiate a protocol, e.g., by simply pushing a button. If all preconditions are met, the roles in the protocol are matched with the actual team members. During the execution of the protocol, the user interface provides information, such as the current state and possible actions in this state of the protocol. Special templates, e.g. for requests, explanations, and responses can be provided, and control is passed depending upon team members' actions.

An advanced prototype, called CROCODILE (=creative open cooperative distributed learning environment), is currently being implemented based on the experiences made with VITAL and SCOPE.

5. Next Steps

We want to investigate whether learning protocols really inherit the advantages of their predecessors: cooperative learning methods and scripts. In addition to structuring the cooperative learning process we also expect them to serve as a means for meta-learning, i.e. learning to learn cooperatively. Field studies will show whether users can create (internal!) scripts by multiple usage of learning protocols and thereby transfer their behaviour to other collaborative situations.

We still have a lot of open issues which require further research, two important ones being the usability of learning protocols in medium/large groups and in asynchronous settings.

- Group size

Most research on scripted cooperative learning (with and without using computers) deals with dyads [Mancini et al. 1998], [Hron et al. 1997] or relatively low structured scripts, which structures the learning process in coarse steps [Hall & Mancini 1997]. Only limited knowledge is available on which methods are suited for which group size. This has to be evaluated by performing extensive testing with user groups of various size.

- Asynchronous learning

A problem for learning teams at the workplace is the need to learn asynchronously, e.g. at times dictated by business requirements. Asynchronous cooperation is also very important or in many cases the only possible solution for dispersed learning teams spread over different time zones. Many of the traditional cooperative learning methods assume synchronous settings and have to be adapted for asynchronous usage.

Further information about the CLear project and the learning environments VITAL and CROCODILE is available at our website http://www.darmstadt.gmd.de/concert .

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A modular approach to education – its application to the global campus

Bruce Elson
School of Engineering Systems and Information Technology
University of Central England
Birmingham B42 2SU (UK)
Email: hf70@dial.pipex.com

Alan. Phelan
School of Computing
University of Central England
Birmingham B42 2SU (UK)
Email: alan.phelan@uce.ac.uk

Abstract: A range of pedagogic, administrative, socio-economic, structural and resource issues surround the establishment of a global campus. This paper identifies and discusses such issues, and suggests that pedagogic aspects are paramount. The limitations of conventional subject-based approaches are considered, and local experience in curriculum design and module integration is discussed in the context of flexible learning, wider access and participation. The need for a range of learner support mechanisms is indicated, and our implementation (together with others) is described. The concept of a global campus is underpinned by appropriate technological developments. Internet- and Web-based experience is discussed, as is the need for more radical approaches such as Virtual Reality techniques.

Introduction

The nature of higher education (H.E.) is changing globally: the convergence of wider access demands, greater emphasis on vocational preparation, new teaching and learning delivery mechanisms, and the emergence of globalised economies is propelling forward-looking H.E. institutions into careful self-analysis. At the same time, many countries (for example, U.K., Australia, U.S.) are witnessing a withdrawal from state-funding for both H.E. institutions and for student maintenance costs. With other but equally significant structural and resource difficulties, developing nations also share these problems (Koul, 1995)

As well as financial challenges, certain global trends are beginning to emerge. Valcke and Vuist (1995) describe experiences in the Netherlands that matches our local experience in the UK. Demographic changes mean that the profile of the traditional student is becoming older, often working or balancing the requirements of other family/career commitments: this implies a growing demand for increased part-time and more flexible learning provision. An increasing number of UK institutions have adopted a modular approach to course design and delivery – see, for example, George, Murfin, and White (1992). At the same time, there are many pressures for more effective teaching and learning delivery mechanisms. Active learning, student-centred and case-led methods are now accepted parts of the educator's canon (Rogers [1991]), and such changes have been growing in influence since the late 1980s. What is now emerging as a radically different and (potentially) revolutionary change is the use of Internet- and Web-based delivery channels.

Open Learning and emancipation

Before discussing such issues, it is worth recalling that one of the strengths of an open learning approach is what Reid (1995) refers to as an 'emancipatory tradition' - the barrier-dissolving aspects of such learning. Such emancipatory aspects are principally associated with learners previously denied access to education and assume a much wider relevance within the context of a global campus. Reid (1995) directs our attention to 'structural constraints' relating to institutional, social, cultural, and political/economic factors. While the cost of commissioning and building new higher education institutions may stretch the financial resources of the developing countries, the ability to 'tap' in to such programmes of study offered via the Web may be of great emancipatory, as well as economic, potential.

This implies fundamental challenges for the future of higher education. Dolence (1995) suggests that these challenges stem from the use of an educational model developed from and for an industrial model of society. Is this appropriate in what Dolence calls an 'information model' of society? Is the cost model of such a paradigm still valid given the nature of such an "Information age"? Can the higher education sector ignore the potential of technologies such as Web-based 'push' technology, 'click-thru' mechanisms, video-conferencing, and virtual reality models?
In a wide-ranging survey of current thinking about pedagogical issues facing H.E. Diana Laurillard articulates the necessity of 'situation-learning' (Laurillard, 1993). Such learning implies that "the acquisition of inert concepts (e.g. algorithms, routines, decontextualised definitions - i.e. the stuff of many university courses) is of no use if the student cannot apply them...[We] have to use our knowledge in *authentic activity*, i.e. genuine application of the knowledge; this allows us to build an increasingly rich understanding of the tool itself and how it operates" (page 17). Here, the application of Virtual Reality models and techniques offers potential for implementation of 'authentic activity' and 'situated learning'.

Globalised education

The idea of a globalised higher education sector - a 'global campus' - implies administrative, pedagogic, operational, and technical issues, and the Virtual Online University (`www.tcet.unt.edu`) offers an interesting metaphor for the learning 'cyberspace'. It is structured around a virtual campus, designated as a 'MOO' (an Object-Oriented Multi-User Dimension), around which students can wander as they would around a physical campus. At the same time, the range of courses offered remains very traditionally 'subject-based'. Is this appropriate to such a new learning environment?

Such an environment may well present a lack of unified focus for learners. Laurillard (1993) draws attention to the decentralising effect of new technology. She argues that this can push forward a very fragmented view of knowledge. This is opposed to, what she typifies as, 'academic knowledge', which has an integrative function different from simply 'knowledge'. It is this reflective aspect which is likely to prove difficult to deliver in the information model described by Dolence (1995). Learners in a virtual campus may well require a much stronger structural identity. It is, therefore, important that there is a strong conceptual platform that integrates and preserves a sense of intellectual and discipline consistency.

Local implementation

At a local level, we have attempted to incorporate such issues and challenges within a conceptual and pedagogic framework for the education of information engineers. A set of modules has been implemented within a conceptual framework entitled Systems, Techniques, Implementation, and Integration (STIMI). An outline of this is shown in figure 1 (The STIMI Progression). In stage 1, the concept of systems and systems thinking is introduced to students. This theme is elaborated in separate semesters in stage 2. The first emphasises the usual systems analysis techniques of process, data, and event modelling. Implementation within the context of Computer-Aided Production Management (CAPM) is combined in the second semester. By stage 3, management and management-information related issues are addressed by examination of strategic and operational planning aspects. The integration of 'islands of automation' within the context of manufacturing businesses is the prime concern of the postgraduate programme. This module is designed to enhance the learning experience of those continuing students who wish to pursue their studies at this level, together with providing a firm base for external students entering the programme from a wide range of industrial and educational backgrounds.

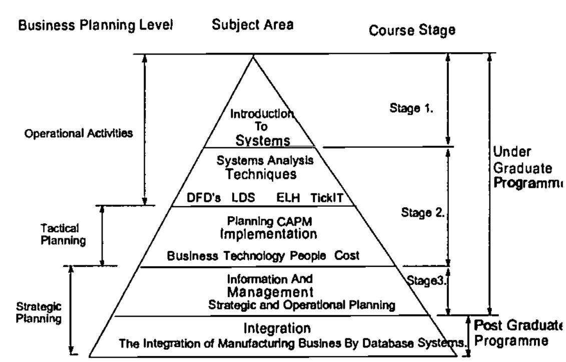

Figure 1: The STIMI Progression

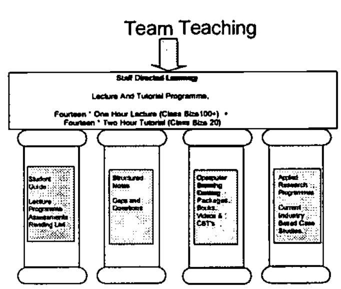

Figure 2: Support for module teaching

The basis of delivery for the modules is illustrated in figure 2 (Support for Module Teaching programmes). A body of structured teaching material (linked and sustained by four pillars that rest on the STIMI conceptual foundation) has been developed to minimise duplication of content and to provide a common platform for delivery. Following Race (1989), this incorporates a range of techniques developed from Open and Distance Learning models, such as self-assessment questions and other developmental questions and activities consolidated within the text.

The particular problems of part-time students, those students beginning their studies at differing entry points, and students who require extra support are recognised, and are of especial relevance within the context of this paper. Such students have significant demands placed upon them by work and family pressures so such students can also access this material via the University web site. Open and distance learning material may appeal to university management because of its apparent cheapness, but such students are likely to require significant support mechanisms. They may be unfamiliar with the nature of independent learning implied by a higher education programme of study. How are such mechanisms to be implemented and managed given an electronic local campus, let alone a 'global campus'? Learner support in the global campus will rest upon two pre-requisites: learner support and technological delivery mechanisms. We will address the latter aspect later in this paper. For now, we wish to describe briefly some of the issues involved in supporting widely-dispersed learners. Such learners may well be dispersed temporally as well as geographically. The use of packaged material (CD-Rom, text-based and other resources) is the conventional means of handling knowledge content. But how can learners benefit from a shared learning experience? Romiszowski (1995) describes how a co-operative programme can be established, and can be extended by various Internet and Web-based technologies - bulletin-board conference facilities, email, links to resource materials (virtual museums, virtual libraries). All of these offer significant potential as an integrated collaborative platform.

Distributed learning

Such initiatives still, however, rest upon a traditional view of teaching and learning. The support of Distributed Learning paradigms should now be considered. Distributed learning is founded on the belief that the personal needs of the student are paramount. Academic institutions can evolve courses based upon modules (STIMI), that can expand choices for students whilst maintaining educational quality across location and time-bound constraints, as well as providing the student with a more self-paced, self directed, career-biased learning experience. A distributed learning environment can essentially be stand-alone with a single subject/operator or can be linked via with a common database and/or other systems into a distributed system/servers. The common database may either be held centrally (and modified if required by each system/server) or local copies can be used with changes highlighted to the other components of the system/network. For example, for a design engineer a distributed learning environment is desirable, but design engineers can be trained individually. For other learning contexts, it is mandatory, especially where teams of operators interact in command and control of resources. An example where a distributed environment would be mandatory is in Air Traffic Control where visualisation of air space needs to be accessed and controlled by many operatives.

Technological aspects

One of the potential problems with distributed learning is data transmission rates over networks. Optical Fibre technology has developed such that within the near future transmission rates of 10 Gigabits sec^{-1} will be possible over broad band optical networks (Chan, 1995). A current or near term technology is the so-called "DVD" CD-ROM (Bell, 1996) where data is written to a multiple layer CD. This technology gives the CD-ROM the capacity to store up to 17 Gigabytes on a single disc with a data rate capacity of 11 Mbits sec^{-1}.

Such technologies (given development) are of direct relevance to Distributed Learning and its application, by affording a platform for the development of such teaching aids as Virtual Reality (VR). Given the inherent ability of VR to display three or multi-dimensional properties of objects to a operator its uses in teaching and training are virtually endless. It must, however, be remembered that VR is essentially only a display tool and therefore cannot fully substitute for other forms of learning. It is also important, given the growing importance and development of VR technology, that VR itself should be taught as a module at core level (STIMI). Being a multi-disciplinary subject it can only be taught at a relatively high level. It should however become a mandatory subject in all information technology courses even if minimum time is devoted to it (Elson, Simms [1997]).

Table 1 below lists some potential applications for VR in teaching. This list is not meant to be complete and many other applications may occur to the reader.

Table 1: Some Uses of VR in education

Subject	Use
Physics	Motion, Orbital Mechanics, Gas Physics, Multi-dimensional analysis
Chemistry	Structure of compounds, molecules
Biology	Structure of organisms, behaviour of organisms
Earth Sciences	Earth observation, landscape
Geography	3-D structure
Geology	Structure of fossils
Engineering	CAD/CAM
General	Display and analysis of multi-dimensional data

For basic tutorial type work the basic technology already exists with PC's and CD-ROM's. For more extensive use lightweight cheap helmet-type displays need to be available along with the appropriate computer technology (fast networks delivering M-Bytes sec^{-1})

In conclusion then, the Global Campus is a rapidly developing field with many potential applications. It has direct application to teaching and training at many levels. Educators should be made aware of the capabilities and limitations of the technology. Distributed systems are required for its effective use. The concept of a Global Campus offers a useful metaphor for the delivery of a new mode of education, supported by fast and flexible delivery mechanisms.

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Agent-Based Instructional Design Model for Cognitive Mapping

Piet Kommers, Lora Aroyo and Svetoslav Stoyanov
Faculty of Educational Science and Technology, University of Twente, The Netherlands
{kommers, aroyo, stoyanov}@edte.utwente.nl

Abstract: This article is purposed to present an intelligent agent-based instructional design model on the subject of cognitive mapping strategy. It is a further conceptualisation of the rational behind the existing SMILE-Maker tool. SMILE-Maker is a prototype of computer programme aimed at supporting the user to build some knowledge and skills in cognitive mapping technique when problem solving occurs. A new instructional design scenario based upon this model has been added to the programme.

Introduction

The ambition behind the agent-based instructional design model is to construct, in more effective and efficient way, the interaction between the learner as a user and the facilitator as a system instructional designer. Cognitive mapping is the content this interaction deals with. Instructional events are supposed to play an intermediate role. The interaction is formalised in the concept mapping format as the gaps in overlapping the behaviour patterns of the user and the system designer are identified and then some advises are provided. It is hypothesised that this computer-based instructional design should solve some of the fundamental all-the-time issues of learning and instruction. What seemed impossible for the domain of instructional design is very likely to happen now because of the new hardware and software development and the more appropriate formalism for data retrieval and knowledge representation. The model tries to balance constructivism and objectivism as instructional design paradigms, content-treatment and aptitude-treatment interaction as didactic approaches, system- and user locus of control in human-computer interaction, and preferential versus remediation matches to individual differences. The article starts with a short description of the SMILE-Maker tool, providing the context that calls for a new instructional model and than an agent-based instructional design model (4 AID) is presented.

SMILE-Maker Tool

SMILE stands for Solution Mapping Intelligent Learning Environment. The SMILE-Maker tool consists of the components such as 'ideas', 'profile', 'map', 'method', 'template', 'partner' and 'draw'. 'Ideas' means creative problem solving techniques. 'Profile' is associated with individual differences. 'Method' proposes a cognitive mapping strategy based upon synergy of problem solving techniques and mapping approach. 'Map' includes types of maps such as concept map, mind map, process map, and flowscape. 'Template' provides with some examples produced in a wide range of particular subject domains. 'Draw' leads to a graphical editor. 'Partner' proposes a strategy and a convention for group problem solving using cognitive mapping method.

Three different scenarios can be recognised in SMILE-Maker tool - instruction scenario, adaptation scenario and laissez-faire scenario. With instruction scenario a user follows a general predefined path. Each information unit (map information collection, map idea generation, map idea selection and map idea implementation) is studied in a fixed order of instructional events - explanation, example, procedure, practice. Adaptation scenario create opportunities for user to identify her- or himself, for example, as a type of learning style, and than to go to the particular direction determined by user preferences. It is expected that different users have tendency to one of the instructional events - explanation, example, procedure, and practice. Laissez-faire scenario implicitly enables a user to construct own learning environment selecting different components and available instructional events in unique order. It is supposed that user will create own cognitive mapping method combining in an idiosyncratic manner the different SMILE-Maker components. The three scenarios might be distinguished according to a disjunctive theoretical framework consisting of two dimensions:

- Objectivism versus Constructivism educational paradigms
- Content-Treatment Interaction versus Aptitude-Treatment Interaction didactic approaches.

Within objectivism/constructivism paradigm an additional dimension of system control versus user control in human computer interaction can be recognised and preferential match versus remediation match to individual differences makes a part of content-treatment/aptitude treatment interaction.

The three scenarios have their either advantages or disadvantages. They dispose themselves on the continuum at the one extreme of which is laissez-faire scenario and at the another pole is instruction scenario. Adaptation scenario takes a middle position. Laissez-faire scenario is with predominantly constructivistic and aptitude-treatment interaction orientation with user locus of control, while instruction scenario has more objectivistic and content-treatment interaction direction, with system locus of control. Adaptation scenario is more objectivistic than constructivistic and it is more close to aptitude-treatment interaction than to content-treatment interaction. The control is located mostly on the system.

A need for designing a new versatile scenario within SMILE-Maker has appeared. The versatile scenario is based upon the *4-AID* instructional design model as an intelligent agent is assigned to take the very important role of facilitator when trying to accomplish a balance between objectivism and constructivism, content-treatment interaction and aptitude-treatment interaction, system control and user control, preferential match and remediation match.

4-AID Model

Generic Agent-based instructional design model consists of four sub-models: user (U), facilitator (F), content (C), and instructional events (IE) (Fig.1).

Learner sub-model is defined by *four* learning style components: activist (A), reflector (R), theorist (T) and pragmatist (P).[1] Learning style is a construct to refer the people preferences to the way of approaching to a learning task and how they behave in a learning environment. Honey and Mumford (Honey, Mumford 92) defined the learning styles of activist, reflector, theorist, and pragmatist in relation to the four stages of learning cycle - experiencing, reviewing, concluding and planning. Learner sub-model is a set of learning style components (LS = {A, R, T, P}) reflecting the behaviour of the user.

Instructional events are presented as explanation (E_{xp}), example (E_x), procedure (P_{ro}), and practice (P_{ra}). The explanation provides information what is the cognitive mapping approach and the rational behind it in the terms of facts, concepts, principles etc. Examples require some templates of different cognitive maps to be available. Procedure explains in the step-by-step format how to construct a sequence of maps - information collection map, idea generation map, idea selection map and idea implementation map. Practice is associated with opportunities to build up some skills in cognitive mapping technique. The large-scale complexity of the instructional approaches might be reduced to those *four* events: $IE=\{E_{xp}, E_x, P_{ro}, P_{ra}\}=\{IE_i \mid i \in N, i \in [1,4]\}$. They represent all variety of the treatments. Different combinations of events, according to the stylistic preferences, enhance the probability to design an effective and efficient instruction.

Content $C=\{M_{InP}, M_{IdG}, M_{IdS}, M_{IdI}\}$ is a set of *four* information units concerning a cognitive mapping strategy: map information collection (M_{InP}), map idea generation (M_{IdG}), map idea selection (M_{IdS}), and map idea implementation (M_{IdI}). Map information collection is purposed to assemble all available information in problem space. Map idea generation is aimed at generating as many problem solutions as possible . Map idea selection finds the best candidate among the alternatives. Map idea implementation operationalises a selected solution in the terms of sequence of events and activities.

[1] There is not enough room to go in details with discussion what is the relationship between learning styles, cognitive styles, cognitive controls, abilities, personal traits and why learning styles have been chosen as representative of individual differences of learner. Learning style is a psychological construct including itself abilities, cognitive controls, cognitive styles, personal traits and prior knowledge.

These sub-models are closely related to each other by the behaviour of the user who influences the behaviour of the system facilitator. Every user's action concerns the sequence of instructional events and content units depending on the user learning style. When the user takes an action $U_{actions} \in IE=\{IE_i \mid i \in N, i \in [1,4]\} \Rightarrow F_{action} \in$ {identifies LS_{ij}, $i,j \in N$ and $i,j \in [1,4]$} U {IE/IEi} it is in respect to the selecting of an instructional event that stimulated facilitator F to come in action and identify user's learning style and make suggestions to him/her for further IE sequence. User's action could be also in respect to content units, $U_{actions} \in C=(IU_i \mid i \in N, I \in [1,4]\} \Rightarrow$ $F_{action} \in$ {identifies LS_{ij}, $i,j \in N$ and $i,j \in [1,4]$} U {IU/IUi} that also stimulates facilitator F to come in action in a corresponding way.

Each learning style manifests the subject's preferences to one of the instructional events. The theorist is very likely to attached him- or herself to the explanation. Reflector should feel comfortable with example. Pragmatic should choose procedure, and activist should go directly to the practice. The four preferences could be reformulated as explanation type, example type, procedure type and practice type. This might provide more room for flexibility in the attempt to deal with the great diversity and complexity of the situations. Learning style is a valid psychological construct, but it is not fixed to a person, a situation or a task. One can be theorist in one situation, or reflector in another.

It is also assumed that the user will demonstrate some preferences to the different content units. The theorist likes information collection map, activist has strong bias to idea generation map, reflector is in his or her own with idea selection map, and pragmatist has a talent to idea implementation map. We could reformulate those tendencies as information collection, idea generation, idea selection and idea implementation preferences that opens the door for more flexibility as well as. The instructional events and the content are stable factors that can accumulate the learning styles. Or put it in another way, individual differences are defined in the terms of instructional events and the content.

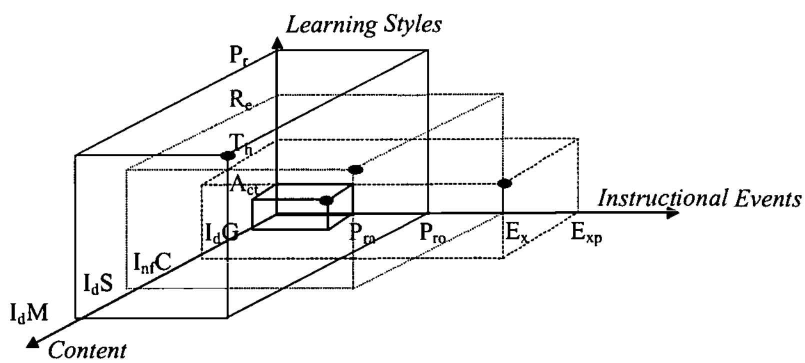

Figure 1: Agent-based Instructional Design Model (4-AID Model)

The behaviour of the facilitator, from the methodological point of view, is premised upon the assumption that everybody has a potential to be complex and flexible in style manifestations, and if it is so, the issue is just to provoke ("wake up") the personal capabilities potential. Facilitator adds flexibility as creating a new versatile style. It is done as it capitalises on the strong points and eliminating the pathologies of any particular style instead to adapt the instruction to the user's stylistic preferences (Stoyanov 97). The agent-based facilitator (F) is patterned by a Master Performer Concept Map (MPCM) which combines knowledge of content, instruction events and user's model. Facilitator monitors user recognising behaviour patterns before reacting on them. This is not only pattern retrieval, but also a pattern assembly. The facilitator identifies the gaps between Master Performer Concept Map ('what should be') and particular user's model ('what is') presented also in concept mapping format. What happens is that user behaviour is a stimulus for facilitator to trigger pattern retrieval on the master concept mapping. If the user demonstrates learning style preferences to explanation type, than the facilitator completes the processes spreading activation to example, procedure and practice. Or if the user demonstrates a pragmatic learning style and starts with procedure keep staying on that strategy, than the facilitator provides opportunities for practice, example and explanation. Thus, the user is free to select the first instructional event (constructivism, aptitude-treatment interaction, learner locus of control, preferential match). At the same time he or she is recommended to take benefits from the whole format containing the other instructional events as the order is not a substantial factor (objectivism, content-treatment interaction, system locus of control, remediation match).

The facilitator imposes the control on the meta-level as well. If the user is mostly affected by instruction scenario, than the facilitator will provide with some suggestions how to become more open to the opportunities for constructing own learning environment and own cognitive mapping method. If the user is determined only to play freely with the SMILE-Maker components, than the facilitator will pop up advises for more structured approach. The facilitator also might identify the user's preferences to the learning after an inventory or a questionnaire has been filled. It prescribes a particular learning path accompanied with some suggestions how to compensate the style's weaknesses.

The working cycle behind *4-AID* model involves user action in respect to the presented content and instructional events. Facilitator recognises and analyses user's behaviour and reacts to it with a specific proposal. This cycle could be repeated on every step in the user-system interaction (Fig.2).

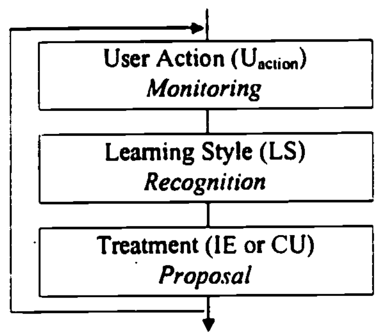

Figure 2: Concept map based diagnostic-treatment cycle of the agent-based facilitator

Facilitator possesses characteristics of a Monitor agent and Helper agent. As a monitor it is operating autonomously watching for a specific event to happen (gaps between Master Performer Concept Map and particular user model). As a helper it performs autonomously instructional or content actions in correspondence with the occurred events. After proposing the 'treatment' for the detected problem it performs automatically analysis of the situation and monitors for other evens. In other words, agent F is monitoring the behaviour of a particular user U_i and based on the concept map knowledge tries to identity user's U_i learning style $Ls_i = \{IE_{ij} \mid i,j \in N[1,4]\}$. The activation of facilitator F is calculated by: $F_{action} = D_{min} \{U_i , IE_{ij}\}$, where D_{min} is the minimum distance between the Master Performer Concept Map ('what should be' stage) and particular user model ('what

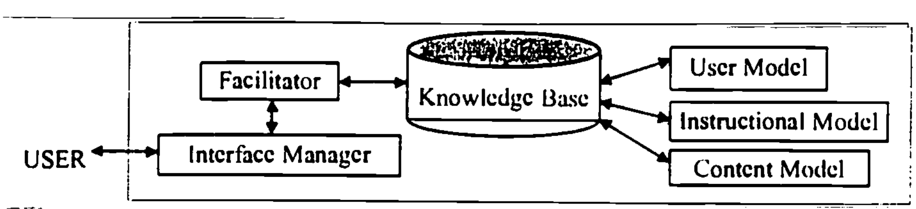

Figure 3: System Architecture

We refer to intelligent agents technology as a proper one to fulfil the tasks of the facilitator in this system. Agent technology enables instruction, user and content concepts to be directly represented in software. Proposed agent-based facilitator meets the dynamic and sophisticated requirement in respect to user modelling in the process of providing instructional material. With intelligent agents, instructional processes and user behaviour are modelled, so that if the processes change this can easily be reflected in the software by changing the interactions, or at most the combination of objects. The actual objects remain unchanged (Aroyo, De Diana, Dicheva 98). Agent technology is our best candidate because of the properties of agents that make them different from the other type of software entities. We present some of the relevant for the facilitator case internal agent properties (from the 'internal being' of agent) that determine their actions (Brenner, Zarnekow, Wittig 98). Although we describe a single agent system in the moment, we would like to leave the space open for employing new agents if necessary. In this respect, we are focusing on some of the external properties of agents that affect the interaction with other agents and human-agent interaction. *Autonomy* is one of the basic agents properties and presents the ability of the agent to follow its goals autonomously without interactions or commands from the environment. The *intelligence* of the agent is formed from three main components: internal knowledge base, reasoning capabilities based on the content of the KB (semantic networks, neural networks) and ability to *learn/adapt* to changes to the environment. Agent is software capable of *reacting* appropriately to influences or information from its environment. It reacts either by having internal sensor or by possessing internal model of the environment. Agent is also *proactive*, that means that it not only reacts to the environment, but also takes the initiative under specific circumstances. The fact that agent can be proactive and take the initiative requires a well defined set of sub-goals within the limits of the main *goal*. In respect to multi-agent systems agents also can *co-ordinate*, *co-operate* and *communicate* among each other and with other entities of the system. In this case we are interested in providing agent means for a single agent system and we are not concerned with their social abilities. Based on all this agent properties we believe that agent technology is the most appropriate one for implementing facilitator behaviour.

From an implementation point of view the semantic net has been considered as the most direct and natural representation of knowledge in SMILE-Maker. A semantic net is a knowledge representation scheme consisting of a directed graph in which concepts are represented as nodes, and relations between concepts are represented as links (Lehmann 92). The analogy of a semantic net to concept map is straightforward and has long been recognised. Semantic net can be used as a unifying representation for a single user model, content units and instructional events or for a group of users. In order to maintain the consistency of the semantic net, rules governing its description are needed. Two classes of rules can be defined: (1) graph-based rules for enforcing structural constrains, and (2) semantics-based rules for enforcing semantic constrains.

The operators on the semantic nets can be generally classified into two categories: semantic net manipulation operators and semantic net presentation operators. Semantic net manipulation operators include creation, copying, modification and deletion of nodes, contents, links and documents. Semantic net representation operators include the generation and display of hierarchical views and semantic net views, and filtered views (Wang, Ghaoui, Rada 97).

At that stage of the SMILE-Maker development, the 'intelligence' of the facilitator is restricted to the master performer model (expert model). The ambition to add 'more intelligence' in facilitator behaviour should be done soon when the 'Partner' component is going to be designed. The idea behind 'Partner' is to build a learning environment for creating and exchanging cognitive maps in group problem solving. The facilitator will take a responsibility on the behalf of the user for initiating a group session, for searching the best team composition, controlling group dynamic process in respect to rules of brainmapping methods (brainmapping pool, pin maps, mapping gallery etc.), brainmapping data- base storage and retrieval. It is expected as well as that the facilitator will 'learn' during this process and will adapt its behaviour according to that.

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The ECIC Electronic Manual - Interactivity at Work

Margit Pohl
margit@igw.tuwien.ac.at
Monika Lanzenberger
e9125087@stud2.tuwien.ac.at
Dept. for Design and Assessment of Technology
University of Technology Vienna
Austria

Lars Karlsson
l.karlsson@magnet.at
Bengt Brattgård
Bengt.Brattgard@itp.lu.se
Dept. for Applied Psychology
Lund University
Sweden

Abstract: The aim of the ECIC (European Continuous Improvement Circles) project is the development and promotion of methods of group learning in innovative organisations. In the course of the project, project members realized that the paper versions of the manual did not convey one of the basic principles of the ECIC methods, that is, a high degree of participation and user activity, in an adequate way. Therefore, an electronic version of the manual was developed which is more interactive than the paper version and which describes the situated character of the ECIC methodologies in a better way.

1. Introduction: The ECIC project

The aim of the ECIC project is to offer public and private organisations and structures a set of flexible organisational instruments, which contribute to enable them, not only to react upon approaching changes, but also to use the new options in a work for continuous improvements. The ECIC project has thus created a "toolkit" of methodologies, designed to support SMEs (small and medium enterprises) and SMOs (local and regional authorities, communities and other organisations) in their internal capacity to deal actively with development and innovation within a continuously changing context. A particular attention is given to the organisation's capacity to profit from developments in science and technology and specially the challenges and chances of IT as part of innovative solutions.

The central element in the ECIC toolkit is the CI-Circle (CIC) - a model for groupbased participatory learning, problem solving and change-management. It builds upon the rich experiences from study and research circles (Eriksson & Holmer 1991, Karlsson et al 1991), in combination with best practices from continuous improvements (CI) work in both the private and the public sectors. The CI circle relies on the dynamics of the group. The group motivates the members to put forward and examine developmental issues important for themselves as well as for the organisation. The search for relevant and valid information and the structuring of this information and the forming of a new understanding of the issues mentioned above are core activities. Traditional ways of acquiring information and for documentation do not always support these activities.

The circle methodology has so far with few exceptions mainly been established in the Scandinavian context, where it forms part of the general societal culture (Gustavsen 1980). The ECIC project tries to disseminate this imminently participatory methodology also in other European countries and contexts where other organisational traditions dominate.

A general dilemma when introducing participatory formats into more vertical organisational cultures, is how to do this in a non-vertical way. One of the consequences of using linear text can be that authors "dictate" the participation through very detailed instructions. This might lead to more activity but hardly more genuine participation. Added to the more general new and increased opportunities that ICT offers the CI-circles in their daily work, the use of inherently activating hypertexts in manuals etc. with a built-in participatory approach, might be an adequate answer to the above mentioned dilemma.

2. The interactive approach of the ECIC methodology and the electronic manual

The electronic version of the ECIC manual tries to inform about the basic ideas of the project in a way which is inspired by the ideas of participation and openness. The electronic manual is interactive and highly structured to support active forms of information processing with the users. These properties do not only reflect the general orientation of the ECIC project, they also reflect the results of recent research in the area of computer supported learning (Kafai & Resnick 1996, Jonassen 1996). There is evidence, that active involvement of users and intensive processing of the material is superior to the more traditional approach of merely presenting the material to the users. People who are interested in the ECIC methods can browse the system freely at their own speed and according to their own needs. They can explore the examples given in the program and try to find out the relationship of these example to the more abstract and theoretical discussions.

In this context, it is also important to make the structure and the interrelatedness of the material transparent (see Fig.1). Users should be able to look at the contents of the subject matter from different points of view. In the electronic ECIC manual there is another page compareable to Fig. 1 which shows the relationship between the study circle concept and the other methodologies from the point of view of the other methodologies - how they use the ideas of the study circle method in their concrete context.

Another important aspect of modern computer supported systems of instruction is the practical relevance and the situatedness of the systems. Real insights can only be gained by discussing theoretical results in the context of real and relevant situations. This is in accordance with the ECIC approach which assumes that the ECIC methodologies can easily be learned by using them in concrete situations. To support this, many practical examples were added to the electronic ECIC manual. In most cases, the methods from the ECIC toolkit are open for creative forms of application. The ultimate goal of the ECIC methodology is to enable the users to find their own solutions for the problems rather than strictly follow any guidelines. The ECIC electronic manual can give a first introduction into this kind of attitude because electronic documents convey a sense of flexibility and malleability much more than printed text which is always authoritative and fixed for eternity.

3. Description of the ECIC electronic manual

In the ECIC electronic manual we tried to implement the desirable properties of computer based educational systems described in the last section: showing the interrelatedness of the material, supporting the active involvement of the users, use of practical examples. In the following, we want to describe the details of this process. It is important to mention in this context, that the project members are active participants in the development of this system.

3.1. Interrelatedness of the material

The structure of the ECIC information system is a rather complex one because of the many interrelationships between the methodologies. In this sense, the topic of the ECIC project is probably an ill-structured domain (Nix & Spiro, 1990). Ill-structured domains consist at least partly of complex concepts with complex relationships between them. These concepts and their relationships cannot be defined easily because of their dynamic character. In this case, it sometimes helps to use diagrams to make difficult ideas more transparent and easier to understand. In the course of the project, the diagram which is shown by Fig. 1 was developed cooperatively, and it is still not "finished". Project members still work on it and change it. Because of its electronic form, this is easily possible. This diagram is a form of a "concept map". Concept mapping is a method to support learning processes. The presentation of concept maps is a more efficient way to communicate ideas in instructional situations (Kajstura et al 1998, Novak & Gowin 1984, Reader & Hammond 1994).

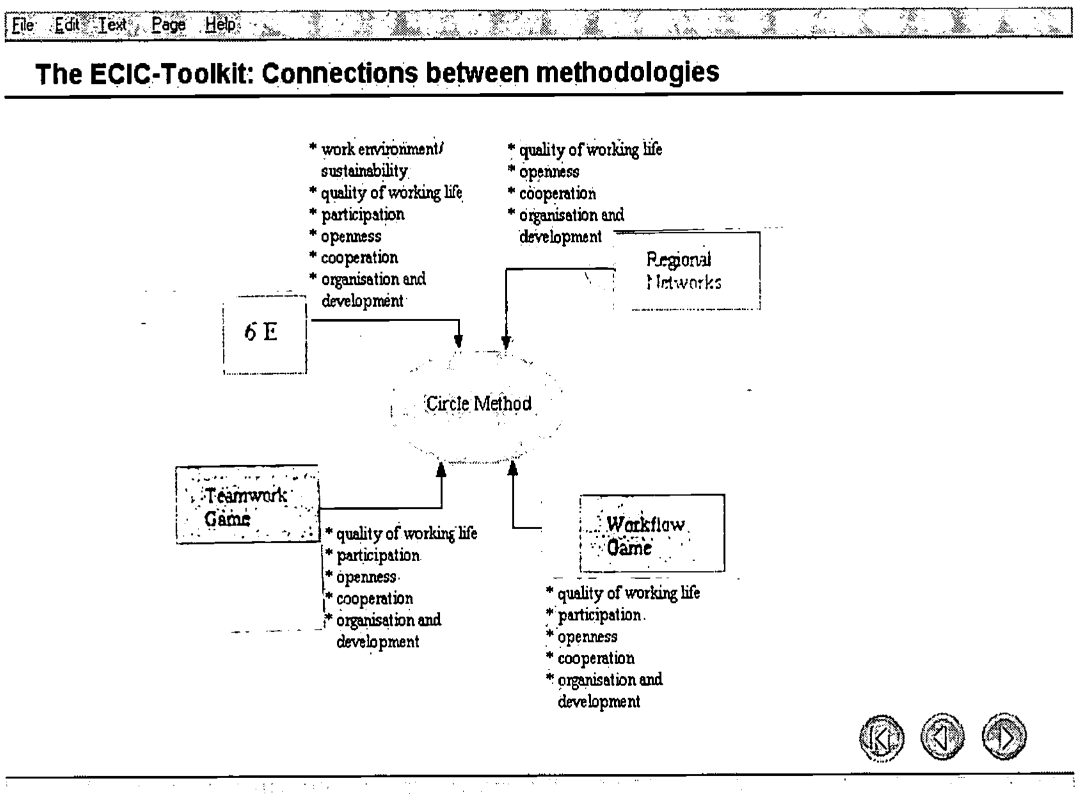

Fig. 1. One of the views of the structure and interrelations of the ECIC methodologies

3.2. Active involvement of the users

The teamwork game (Fig. 2), one of the methods of the ECIC toolkit, shows, that working and playing at the same time can develop a very interesting symbiosis for reaching a company's aim in a teamoriented way. The philosophy of the Teamwork Game is that ideally, working as a team everyone can profit from each other's knowledge and skills. Working in a team is a step towards becoming a learning organization and achieving a continuous stage of development. There are some basics for teamwork, e.g. "getting to know each other", "developing co-operation, interaction and communication skills", "becoming aquainted with group phenomena", "practicing anticipation, identifying and solving problems".

In the game different questions are put forward which concern the above mentioned teamwork disciplines. The players can choose, if they want to score points and someone wins with the highest score or if groupdynamical processes are prefered. The multimedia documentation of ECIC shows, by presenting some examples, how easy playing this game is. Moreover it should motivate people who are a part of an organization to play it. In order to play the full version you have to contact the authors responsible for the Teamwork Game at the Helsinki University of Technology. During the phase of implementation the question arose, if it is possible to learn teamwork-skills by using a computer program, sitting alone in front of the screen of a machine. But in our opinion teamwork-skills are not developed by the program itself.

The object of the computer program is predominatly to encourage people to reflect on their own situation in an organization. This accomplishes the goal of acquiring these skills because the game enables them to feel responsible for solving the problems or at least wish to participate and thus knowing that they are solvable. Using this multimedia documentation should shift the players focus on real situations and problems in an organization, which have to be dealt with in real life rather than by a computer game.

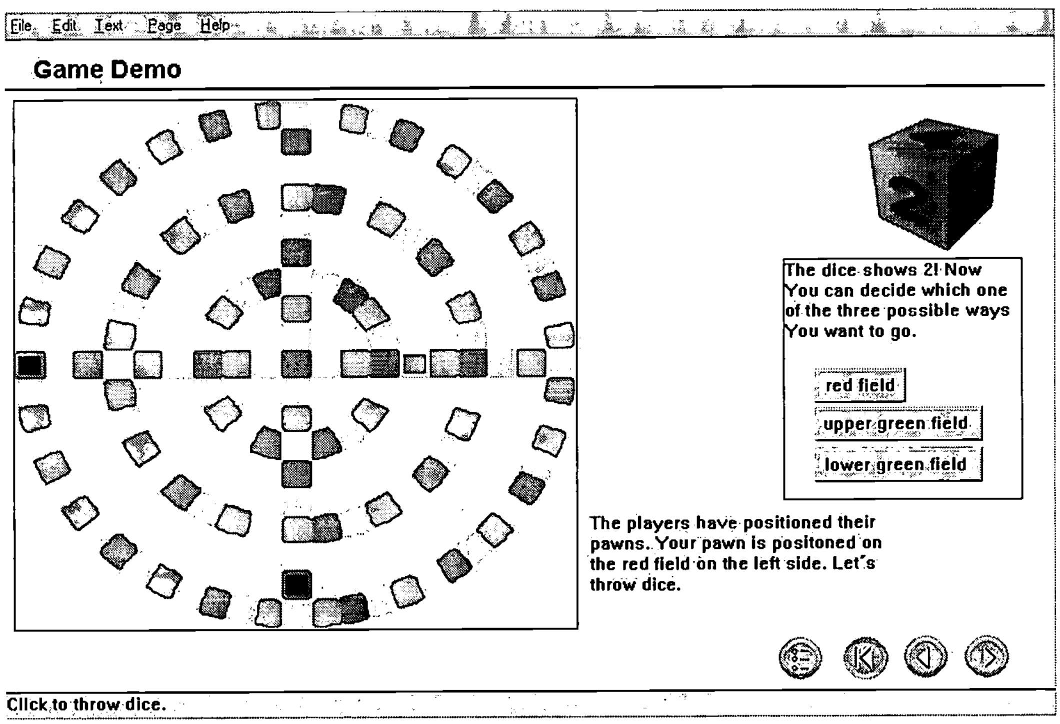

Fig. 2. The gameboard of the Teamwork Game

3.3. Use of practical examples

The study circle method is described at great detail in the electronic ECIC manual because it forms the basis for all the other methods in the ECIC toolkit. The basic idea of study circles is very simple. A group of people meets regularly to learn cooperatively. Nevertheless, it is very difficult to apply this method because much experience is necessary to make study circles work smoothly. Reality is often richer and more varied than any manual can anticipate. Therefore, it is often useful to show the application of theoretical principles in the context of a concrete example (Kommers et al 1996).

Early on in the project, a group of Spanish female entrepreneurs, who formed a study circle, complained that the manuals contained no practical examples showing ways how to implement this method successfully. Therefore, we included two concrete examples of study circles in the electronic ECIC manual. It is possible to look at the more theoretical guidelines for running study circles and at the concrete examples in parallel. There is a complex web of links between the guidelines and the examples. In this way, it is possible to jump from a specific guideline to a description of the concrete realization of this guideline and back again. This very rigorous use of the concrete examples in the electronic ECIC manual also showed deficiencies in the paper version of the manuals and led to a reformulation of these manuals.

4. Conclusion

The ECIC electronic manual differs fundamentally from the paper version. It can therefore provide specific support for people who are interested in the methods of the ECIC toolkit (e.g. study circles, teamwork game). It allows users to browse the material at their own convenience and motivates people to develop their own views about the ECIC methodologies. It supports a more active and critical approach of the users towards these methodologies. Furthermore, the interrelated character of the methods can be represented more detailed and from different points of view because interactivity is a main focus of the ECIC electronic manual. The electronic manual includes several practical examples which show the situated character of the various methods. In this way, the electronic version of the ECIC manual can motivate users to a more active, critical and participative behavior than the paper version. This is especially important because it corresponds to the main goals of the ECIC methodologies.

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Virtual Reality Model Access Project (VR-MAP): Helping Individuals With Disabilities Develop Social Self-Sufficiency

Dr. Clark Germann
Associate Professor, Technical Communications
(303) 556-3453
germannc@mscd.edu

Dr. Jane Kaufman Broida
Professor, Human Performance, Sport & Leisure Studies
(303) 556-2978
broida@mscd.edu

Metropolitan State College of Denver
Technical Communications Department
Campus Box 35, PO Box 173362
Denver CO 80217-3362 USA

Abstract

The Virtual Reality Model Access Project (VR-MAP) plans to design and develop a prototype for the application of virtual reality technology to the enhancement of the social self-sufficiency of individuals with physical disabilities. VR-MAP will utilize Quick Time Virtual Reality software to create virtual experiences that can be computer accessed through a web page on the Internet or through provision of free CD-ROMs. The prototype created for this project will consist of' 2Osites placed into virtual environments. Using the computer mouse or an adaptive device, individuals will be able to "navigate" through the various environments or access "hot spots" indicating each photographic scene. Annotations about access issues will be provided for each site. Head-mounted displays (HMD), hardware similar to goggles with small computer screens, will be available to provide individuals with an immersive experience. A "head tracking" feature on the HMD allows the user to look at a scene by simply moving the head, and when realistic audio is added, the user can be provided with an experience that simulates reality. In order to use this prototype to assist individuals with physical disabilities integrate into society, certified therapeutic recreation specialists will be trained to access the technology. As hospital lengths of stay become shorter, helping clients ease back into society "virtually" might be a viable addition to traditional therapeutic approaches which seek to maximize self-sufficiency. By enhancing social self-sufficiency of individuals with physical disabilities, it is anticipated that carry-over into employment, independent living, family support, and economic independence will occur.

The promise of virtual reality (VR) technologies to provide powerful and unique educational and informational experiences is well known (Heim, 1998). Unfortunately, the public has often turned away from these technologies when expectations went unfulfilled due to hyperbole on the part of the media. Despite setbacks, however, use of VR is growing and will soon become commonplace, according to some researchers (Von Schweber, 1998). Currently, researchers at Metropolitan State College of Denver are using VR to assist individuals with physical disabilities become more self-sufficient. Specifically, VR software is being used to model various public buildings and other sites that individuals with disabilities may want to visit. Therapeutic recreation specialists then use the software with patients to allow them to virtually preview sites that they may later want to tour in person. This approach may build confidence in the clients and may lead to greater independence once they reenter society. By enhancing this social self-sufficiency, it is anticipated that carry-over will occur into employment, independent living, family support, and economic independence.

Need and Target Population

One in seven Americans, or 35 million individuals, have a disability severe enough to interfere with life's day-to-day activities (Scherer, 1996, p. 4). Of those individuals, 305,000 reside in the City of Denver, Colorado (United States Census Report, 1990). Providing avenues for these individuals to maximize their full inclusion and integration into varied aspects of community life is essential.

Statistics support the need for inclusive, transitional services. Figures indicate that over 1,500 youth with disabilities are preparing for transition into the community from the public schools (Denver Public Schools, 1994). Furthermore, clinical agencies (e.g., rehabilitation hospitals) in the Denver Metropolitan area have over 1,600 new patients each year (Denver Parks and Recreation Special Needs, 1996), with over 200 referred to community-based services annually (Denver Parks and Recreation Transition to Recreational Activities in the Community, 1994, 1995).

A number of factors have influenced the growing need for integration of individuals into society. With advanced medical care available, individuals with multiple and severe injuries are surviving traumatic accidents. Additionally, due to medical advances, individuals with chronic illness are living longer and demanding the services and resources to enhance their quality of life.

The national trend of hospital-based services toward managed care has also impacted the need for inclusive services. In rehabilitation, this managed care includes regulation and monitoring of patient lengths of stay and generally, shorter lengths of stay. As people transition back to the community in shorter amounts of time, providing the resources for their full inclusion and integration into society becomes paramount.

To assist individuals with disabilities transition back to their home environment from hospital settings, healthcare professionals (e.g., physician, physical therapist, recreation therapist, occupational therapist, speech pathologist, social worker, and case manager) work cooperatively to plan patient treatment. However, due to shorter lengths of hospital stays and the need to manage fiscal resources, patients are discharged quickly after achieving medical goals. While the individual with the disability has been medically stabilized, moving that person to successful independence in the community might not have been realized. This is especially true for individuals with severe disabilities that utilize adaptive equipment (e.g., manual and electric wheelchairs, and walkers). Not providing the opportunity to experience use of this equipment outside of the hospital facility prior to discharge is unfortunate for the consumer. In fact, people with disabilities have expressed their fear of injury in new environments (Scherer, 1996, p. 77), and research has suggested that 36% of the women with physical disabilities that were surveyed indicated unfamiliar surroundings as a barrier to social involvement (Boyd, Coyle & Shank, 1998).

To mitigate these negative influences requires new approaches. It is proposed that virtual reality environments be created to help transition individuals back into the community. Virtual reality integrates computer graphics, body tracking devices, visual displays, and other sensory input devices to immerse a participant in a computer-generated environment.

Thus, the Virtual Reality Model Accee Project (VR-MAP) will attempt to answer the following question: Can virtual reality technology be used effectively to assist persons with physical disabilities transition from clinical therapy into the community?

Review of Literature

Definitions

The concept of virtual reality as we know it today was developed during the late 1960s by researcher Myron Krueger (Heim, 1996). Since that time, VR has been so widely used that that it is nearly impossible to reach a consensus as to what the term really means. Here are a few examples:

"(VR) can be defined as a class of computer-controlled, multisensory communication technologies"--(Biocca, 1992, p. 5).

"Virtual reality is an alternate world filled with computer-generated images that respond to human movements. These simulated environments are usually visited with the aid of an expensive data suit which features stereoscopic video goggles and fiber optic data gloves" (Greenbaum, 1992, p. 58)

"Virtual reality is an event of entity that is real in effect but not in fact" (Heim, 1996, p. 16). This definition is expanded to list seven concepts that currently are guiding VR research. (1) Simulation--use of computer graphics and digital acoustic space sound to realistically represent an object, site, or other "reality"; (2) Interaction--ability for the user to interact with objects and other representations within the artificial world; (3) Artificiality--Extension of the term VR to include everything artificial; (4) Immersion--

ability to achieve the illusion of being submerged in the artificial reality. (5) Telepresence--ability to achieve robotic presence at another location; (6) Full-body immersion--use of data suits, gloves, goggles, and other items produce a wide range of sensory representations, including visual, aural, and tactile; and (7) Networked communication--ability to achieve all or some of the above concepts over a computer network.

Little of what today is called "virtual reality" includes use of all seven of these concepts. However, the technology is being used successfully today in numerous applications with various combinations of the seven elements.

Major applications of VR

In addition to specific health care applications, which this paper deals with in depth, VR is being used in a wide variety of other disciplines and industries. Although most use centers around information and education, the telepresence function is being used in areas where hazardous environments and remote locations prohibit use of humans to perform the tasks. Examples of widely disparate uses of VR today include:

--Use by NASA to train astronauts in International Space Station operations (Covault, 1998).

--Use by companies such as Motorola to train assembly line workers months before the lines are actually completed and operating (Minehan, 1996).

--Use by NASA to realistically portray the surface of Mars as a result of exploration by the Pathfinder mission (Jet Propulsion Laboratory, 1997).

--Use in theatrical productions to produce more complex, elaborate, and realistic sets (Reaney, 1996)

--Use in the courtroom as forms of evidence (Dunn, 1997)

Use of VR in Health Care

Virtual reality literature also discusses many benefits for patients. Rothbaum, Hodges and Kooper (1997) reduced the fear of heights in patients after virtual reality exposure therapy. Wilson, Foremen and Stanton (1997) demonstrated that spatial information acquired by physically disabled children from exploration of a virtual environment will transfer to a real-world equivalent environment; Ring (1998) has suggested that patients with disabilities can be trained with virtual reality to judge architectural barriers and tackle environmental obstacles. The researcher advocates the use of virtual reality as a significant assistive technology in the future (Ring, 1998). This clear support of technology deserves the opportunity for development, not just to provide individuals with simulated experiences but to use the technology for the integration of people with disabilities into society.

Methods

The Virtual Reality Model Access Project (VR-MAP) is designing and implementing a prototype for the application of virtual reality technology to enhance the social self-sufficiency of individuals with physical disabilities. As hospital lengths of stay become shorter for patients with physical disabilities, helping them ease back into society "virtually" may be a viable addition to traditional therapeutic approaches. It is hoped that this enhanced social self-sufficiency will carry-over into employment, independent living, family support, and economic independence.

The prototype created for this project will consist of VR models of 20 public sites in the Denver, Colorado area that individuals with disabilities may want to visit. Examples include libraries, airports, recreation centers, sports stadiums and arenas. In addition, other facilities frequently used, such as public transportation, will be represented virtually as well.

Most Effective and Appropriate Technology

Two technologies, Virtual Reality Modeling Language and Quick Time Virtual Reality, were considered to accomplish project objectives. Virtual Reality Modeling Language, or VRML, allows three dimensional structures to be produced from blueprints or from "scratch" by a graphic artist. Complex buildings, objects, and other elements will be produced using this technology.

The second technology considered was Quick Time Virtual Reality (QTVR), a product of Apple Computing. Instead of producing models from blueprints or photographs, this technology uses actual digitized photographs of existing structures. Multiple photographs are "stitched" together to produce a larger panorama. This panorama can then be traversed by the user in much the same way as VRML. QTVR also allows for stereoscopic head-mounted display, head tracking, and sound.

Both of these technologies were pilot tested by Dr. Clark Germann and Dr. Jane Kaufman Broida, and it was decided that QTVR was the desired and most effective technology to use in developing the VR-MAP prototype. QTVR can be viewed by users with Internet access on the World Wide Web or on a stand-alone computer using a CD-ROM. Use of the Web allows for broader and more convenient distribution of the prototype.

Two means are available for the user to "navigate" through the various scenes of buildings and other objects. First, various scenes are linked together so that the user can tour a building by using a series of mouse clicks. Second, a map of the area is available with "hot spots" indicating each photographic scene. By clicking on a particular spot on the map, the user is quickly transported to that location. Additional information concerning each scene is "annotated" into the margins. These annotations provide additional information useful to persons with disabilities, including location of handicapped parking, availability of electronic doors, and location of elevators, and accessible drinking fountains.

With additional hardware, users can become more "immersed" in the scene. The hardware consists of a head-mounted display (HMD) that is similar to goggles with small computer screens for each eye. The HMD allows for stereoscopic viewing of the scenes that add to the realistic effect. In addition, the HMD contains a "head tracker" that allows the user to look around a scene by simply moving the head. A third element that adds to the immersive experience is that of sound. Realistic audio, such as that of a door opening or a wheelchair lift rising, completes the effect.

This technology is the most effective and appropriate currently available considering the likely computer equipment and Internet connections available to the user with a disability. QTVR is also "cross-platform", meaning it can be used on PCs, Macintoshes and other types of computers. Virtual reality technologies change and improve rapidly and these would be closely monitored during the course of the project. If better technologies emerge, the the project would consider taking advantage of them.

Developed on Sound Conceptual Model & State-of–the-Art Technology

An extensive literature review was conducted into both the available virtual reality technologies (i.e., VRML and QTVR) and use of virtual reality for individuals with disabilities. This research resulted in the formation and implementation of a pilot project, funded through the Provost's Incentive Grants at Metropolitan State College of Denver (MSCD). The pilot project tested application of VRML and QTVR and began to use the technology for the integration of individuals with disabilities into the community. From the pilot project, it was determined that QTVR was the preferred technology and that using virtual reality did, indeed, positively impact the transition of individuals with disabilities into the community (Germann & Broida, 1998).

QTVR sites were researched and located on the Internet. No specific applications were found that were being used for previewing access to sites and locations for people with disabilities. However, many sites were found that provided a preview to physical environments for other purposes. For example, the Dallas Cowboys professional football team (http://www.cowboys.com) uses QTVR to allow prospective season ticket holders to view the playing field from a variety of locations with the stadium prior to making a decision. A number of home builders use QTVR to allow potential customers to walk through new houses before they are constructed. Volkswagen uses the technology to allow prospective buyers to inspect new models on the Internet prior to going to a dealership, and Purdue University provides a virtual tour of their campus (http://www.tech.purdue.edu/resources/map). It is interesting to note that providing three-dimensional experiences are becoming more common place in society. This is best evidenced by the provision of 3-D glasses in the August issue of National Geographic.

Development and Testing in Appropriate Environment

The virtual environment will attempt to simulate electronically the actual environment to the greatest degree possible. Technology today allows for the use of photo-realistic images within which the user can navigate to some degree. By using the mouse, the user can move left and right, up and down, and zoom in and out. In addition, these images may then be linked to other images located nearby. Development will also include a map of the facility or object and annotations containing information useful to persons with disabilities.

The technologies and techniques for allowing the individual with the disability to preview public buildings, recreation centers, and other locations prior to an actual visit will be developed and tested in therapeutic environments including rehabilitation centers and community-based settings. Agencies that have provided assurances of participation include Craig Hospital, University Hospital, M.S. Adult Day Enrichment Program, and the City of Denver Parks and Recreation Department: Special Needs Program. Dr. Dennis J. Matthews, medical director of the Rehabilitation Center of The Children's Hospital, has provided a letter of support for the project.

Herrick and Associates will be contracted to test the prototype with the target markets. They will conduct the alpha and beta testing with each user group, varying the applications. Further qualitative data will be gathered from a Consumer Advisory Council and the therapeutic recreation specialists using the prototype with their clients.

Assessment

The research question for this project is as follows: Can virtual reality technology be used effectively to assist persons with physical disabilities transition from clinical therapy into the community? To assist in answering this question, patients who have used VR-MAP will complete questionnaires and respond to interview questions. The questionnaire consists of 78 items in the following categories: background information and VR technology preference; importance of VR features; assessment of leisure participation.

Interview questions will be individual and site specific and will follow-up on questionnaire items.

Results

Since this is a work in progress, questionnaires and interview summaries had been neither completed or analyzed at the time of this writing. However, anecdotal evidence gathered in testing phases of the project has been positive.

1. The VR software was initially tested with one of the project coordinators Will Spence. Spence is a 21-year-old, student at Metropolitan State College of Denver who uses a wheel chair and is afflicted with multiple sclerosis. He indicated that the ability to virtually tour a public facility before going there in person could help reduce his anxiety of making such a trip.
2. The program was also shown to a group of 30 persons at the Rocky Mountain Multiple Sclerosis Center Adult Day Enrichment Program. Users responded very positively to the ability of VR-MAP to assist them in visiting sites throughout the Denver area. Specifically, users mentioned the usefulness of preparing them to navigate older sports stadiums that were not constructed with access features.
3. The program was demonstrated to 70 professional recreation therapists at the American Therapeutic Recreation Association 1998 Annual Conference. Reaction to the project was overwhelmingly enthusiastic and positive.

Discussion

The idea that patients can be assisted through the use of artificially created worlds is indeed seductive. Literature reviewed as a part of this project indicates that the technology and processes are advanced enough to meet the goals set forth. However, several factors need to be considered:

1. No literature could be found indicating that VR has been used before for the specific application of assisting individuals with disabilities successfully transition back into society. Thus, no predictions of success can be made at this point in the project.
2. Although it has been around in some form for many years, VR technology as defined by Heim is still in its infancy. As with much advanced technology, hardware, software, and techniques change rapidly. The technology chosen for this project--QTVR and VRML--could quickly become obsolete.
3. Thus, it is obvious that significantly more research is required before projects such as VR-MAP can become truly useful and helpful.

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Case Tools for Organizational Performance in Instructional Technology Evaluation: CREDIT & IDEA.

Mike Dobson, Bill Hunter, Janet McCracken, Larry Wenger & Tim Buell.
THE LEARNING COMMONS
University of Calgary
2500 University Drive N.W.
Calgary, Alberta, CANADA, T2N 1N4
Telephone: (403) 220-6498 Fax: (403)282-3005
Email: mdobson@ucalgary.ca

Abstract: The "lessons learned" project uses empirical methods to support quality improvement for several technology integration projects at the University of Calgary. Meeting this goal led to several challenges and discoveries that may be of interest to similar projects. The project began with the expectation that some of these challenges may be met with case-based performance support tools. Two case-based tools formed the technical backbone of the project. An instructional design evaluation agent (IDEA) guides users to select evaluation strategies. The IDEA tool is embedded in a case repository of evaluations and designs for instructional technologies (CREDIT). These two performance tools have supported around twenty development projects over an eighteen month period. Two major design hypotheses drove assessment of the tools. The first conjecture has implications for improved efficiency in organizational learning systems. Developing case studies for case-based learning systems represents an overhead in the development process and can be very time consuming. The CREDIT case-library is constructed from documents created during the normal development schedule. Our first conjecture was that storing these artifacts would present less time outlay for projects than building post-hoc case narratives. The second conjecture was that the information contained would be more representative of events and decisions than post-hoc case stories. Experimental use investigated the accessibility of "lessons learned" from repository artifacts. We expected that retrieving "lessons learned" from these artifacts would be difficult, but believed experimental use would clarify any special requirements for retrieval mechanisms and perhaps particular information designs that would improve users access to useful case elements.

Evaluation practice and the case model

Case-based repositories for learning and performance support represent a promising approach to some of the difficulties of organizational and workplace learning (Guzdial et al., 1997; Leake, 1996; McCalla et al., 1997). Case-based learning deals with some perceived limitations of conservative instructional design by, increasing engagement through collaborative group work, increasing authenticity through focusing on real experiences, supporting knowledge construction through reflective practices, and improving transfer through encouraging comparison between problems and cases (Leake, 1996). Case repositories have been successfully used in problem-based learning and some studies even show learners improve their argumentation skills particularly when the repository is linked to specific support for reflection (Kolodner et al., 1997). The case-based approach may be superior to less structured resource-based approaches. Learning in a problem-based situation from disordered materials, for example from the internet, requires considerable support (e.g., Dobson & McCracken, 1997). Structuring cases so that learners can predict length and outline headings, may supports learners' use of resource based information. Providing cases in a similar template is the simplest use of case-based learner support.

Workplace and organizational learning tasks are often relatively formalized and supported by pre-constructed forms and quality assurance manuals. In these situations, case-based approaches can benefit from more sophisticated fine-grained case-based reasoning techniques that automate some of the case-related processing (e.g., McCalla et al., 1997). These systems provide a kind of just-in-time support for learners who reach an impasse in their work. Accurate case comparison allows presentation of appropriately similar cases to help the learner overcome their immediate problems.

Learners using case-based systems without these support features have sometimes been limited by their problem solving skills. Even when cases are well designed and relevant to the target problem, learners may still need support to help them manually compare, match and synthesize cases (Guzdial et al., 1997). Although forms and quality manuals mirror a significant proportion of organizational effort, a lot of work in organizations cannot be easily systematized in this way. Computer-based courseware development and evaluation is one such areas. Although several projects have aimed for reliable computer based courseware production models (Dobson, Rada, Chen, Michailidis, & Ulloa, 1993; Kaye, 1993), the scope for improvement and variation seems not to have diminished. The processes of courseware design, implementation and evaluation can only partly be systematized. The current development practices in computer-based learning systems at the University of Calgary, suggested the need for attention to evaluation processes. Enhancing the implementation and understanding of evaluation practices for technology based learning systems is a high priority of the "lessons learned" project. Empirical methods of evaluation, particularly those intended to inform design, evidently form an important part of an organizational learning strategy.

Evaluation of technology-based learning is a good example of a domain undergoing constant improvement. This alone makes provision of case-based support difficult and makes fine-grained case-based reasoning support (e.g., McCalla et al., 1997) extremely difficult. Universities may provide the additional challenge that researchers from different disciplines have a variety of conceptions about evaluation. Conceptions of evaluation vary on the questions it can address, the stage of development when it is best implemented, the data to collect, and which methods of analysis are useful. Established research methods in each discipline loosely reflect assumptions about evaluation methods. Assumptions are also sometimes a reflection of dominant methods of assessment in non-technology based learning. In fact, several schools of research have developed methods that can be used, sometimes with modification, to support improvement of computer-based learning systems. Market researchers pioneered the focus group, economists created the cost-benefit and impact analyses, learning sciences created the phenomenographic study, program evaluators make extensive use of surveys, experimental psychologists have championed the controlled condition study, and computer scientists have developed several methods for assessing usability. The IDEA system is designed to support users in their selections from alternative evaluation approaches.

The IDEA and CREDIT systems are one part of the "lessons learned" project. Overall, the project has roles in communication, professional development and training. An important element of all parts of the project includes the improvement of learning system design through the use of empirical methods.

The instructional design evaluation agent (IDEA)

Evaluating technology integration systems can be thought of as a set of communication and documentation processes. Activities in group organizations often require a sequence or collection of documents to be written by individuals in special roles. The individuals who have those roles must also have required skills to adequately complete their tasks. This approach to modeling many collaborative work processes has been developed in several object oriented languages including AMIGO (Advanced Messaging in Group Organizations) and AME (Activity Modeling Environment). A review of these and other object-oriented group modeling languages can be found in (Hennessy & Benford, 1989). The AME and AMIGO languages were used to model several aspects of collaborative authoring of courseware in order to design a distributed support system for designers of computer-based learning (Dobson et al., 1993). The IDEA system uses a variation of these object oriented models as a simple visual language to demonstrate evaluation approaches supported by the agent. The diagrams are also used as an interface to descriptive materials, document templates and fully implemented cases stored in a repository.

The agent currently includes descriptions of twelve evaluation protocols. Each is a condensation of research from several sources that emphasizes the practical steps and skills needed to implement a study with the protocol. The methods come from many different disciplines of research and evaluation. Some, for example, are motivated by conversation theory (Pask, 1984), including a conversational breakdown protocol (Laurillard, 1987) that has been successfully used in evaluating distance learning environments (Dobson & McCracken, 1996). Other protocols are distinctly qualitative, including a "connoisseur method" that draws on "Arts-based" approaches to evaluation (Eisner, 1991) and a version of the "phenomenographic" approach that draws on

Marton's work (e.g., Lybeck, Marton, Strömdahl, & Tullberg, 1988). Methods developed for marketing, such as the "focus group" protocol (Flores & Alonso, 1995; Krueger, 1994) can be useful for establishing and elaborating the views of people involved in technology integration. The focus group protocol is included in the IDEA tool.

The IDEA tool provides users with templates for many of the documents typically used in each of the protocols. All empirical projects that use human subjects, for example, have certain ethical obligations to the university . These obligations are dealt with in a proposal to an ethics committee. Projects must describe the proposed experiment and provide a copy of any instruments used. Provisions for getting the informed consent of all subjects and for describing the nature of the study are included in a template proposal to the ethics committee. Since most of the study approaches use human subjects, the template forms an important component of the IDEA tool. As completed documents, such as the ethics proposals are generated, they are intended to be stored in the case-repository.

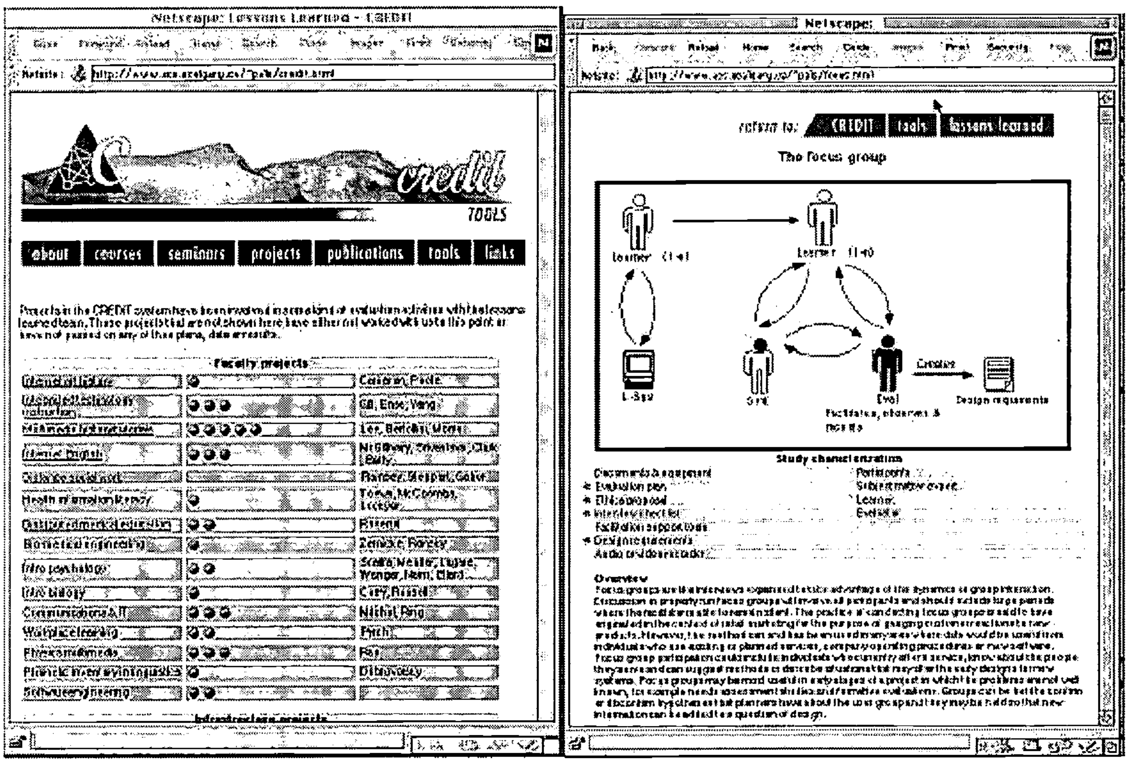

Figure 1: Left, the CREDIT tool, showing tabular view of project progress, and right, a page from IDEA showing description of objects, roles & documents in the focus group evaluation protocol.

The initial design for IDEA included a plan to elaborate several heuristic-conditional rules that when implemented, would guide project directors to select evaluation strategies best suited to their project needs. Several guiding principles were considered. For example, many of the qualitative approaches, including the "phenomenographic interview" can only produce useful data once the development has reached a suitable stage. Other evaluation strategies such as the "connoisseur" approach can determine that the courseware is ready for these other protocols. Before these qualitative studies are really useful, the evaluators need to know that users will have no special navigation or other interface related problems. These qualitative studies can capture learners' subtle misconceptions about a topic, but not if subjects are consumed by difficulties operating the software.

Access to the development team may also affect selection of appropriate methods. Many integration projects choose to buy ready-developed courseware, rather than develop their own. Evaluation methods designed to provide information for improving product design, may be less valuable in these cases than approaches designed to compare competitive products. These and several other heuristic rules have been tracked during face-to-face interactions with the development projects in the university program.

A case-based repository for evaluation & design of instructional technologies (CREDIT).

Most users of the CREDIT and IDEA systems are engaged in a technology development project and are beginning to plan an evaluation study. Users can benefit from reading about similar projects that have gained by failure-driven or success-driven learning. Users benefit, more directly, from seeing worked examples of documents that they are responsible for writing. Projects that have implemented the same kind of study, but perhaps in a different topic discipline, are likely to contain useful information that can be quite easily transferred to the user's particular needs.

At least two factors make it difficult to implement all desirable case-based functionality. There are no pre-designed forms for evaluation of technology-based learning, and the practice of evaluation in this field is constantly under revision. Lack of a consistent methods of technology evaluation leads to difficulties in indexing cases. Only loosely structured cases would normally be possible for similar domains, and this limits the sophistication of possible case-based reasoning approaches.

The CREDIT tool uses a practical and potentially valuable indexing system that depends almost solely on normal project activities. Project development requires several stages of effort that are often represented directly by a document. Examples include the project proposal, a description of course objectives, the ethics committee evaluation proposal, meeting minutes, instruments used in evaluation, interim and year-end reports, external audits and self assessments. The CREDIT architecture makes names of these documents stand for the case outline in the case repository. When a case is retrieved in the simplest of retrieval strategies, all the documents relating to a project are presented.

A case-library populated with this historical record of decisions, hypotheses, discoveries, timing, researching and iterative outcomes holds many, if not most, of the "lessons learned" during a project's life time. It is possible that these results will be more difficult to retrieve from such a repository than from a case library built from hand crafted cases. One of our design conjectures, however, is that this approach may support two major advantages over other case-based approaches, (1) the cost and consequent likelihood of cases being created, and (2) the accuracy of the record.

The combined CREDIT and IDEA tools are designed to be used by two major groups of users. The more obvious group are project developers actively working on evaluations of their computer-based learning. These users can browse any of the pages without guidance, retrieving the materials as simple resource-based support. Beyond browsing, the evaluation agent provides direction to appropriate evaluation models, templates and cases. The IDEA tool is designed to prioritize information for the user based on knowledge about the relevance of the case. Active project workers may also see which documents have been submitted by other projects in the same group, although they are not able to read those documents unless the owners have made the pages public.

An evaluation support team are less obvious users of CREDIT and IDEA, however the advantages for management and organization for this group are quite considerable. A tabular view of project progress is based on our process-oriented approach to evaluation (Dobson, McCracken, Hunter, Gaines, & Wenger, 1996). Projects generally pass through several stages of development before completion. The exact sequence of milestones may differ between projects and may or may not be accompanied by a formal document. A tabular view of documents that have been completed gives quick progress information on each project. Projects faced with immediate document needs can be quickly referred to the author of a similar document in another project.

Conclusions

During eighteen months of preliminary research, development and implementation the project has produced several valuable insights that might be of interest to others considering similar projects. These insights will partly guide the next stages of our work in supporting technology-based learning initiatives in the University of Calgary.

Tracking the value of heuristic-conditional rules during our interaction with projects revealed an overarching factor important in methodology selection that had not been previously considered. Different departments and faculties often have experience with their own preferred research methods. Unless the particular discipline's research methods are difficult to apply to technology based learning (say Historians), this factor influenced preference for study types more than any other. Early indications suggest that researchers without applicable research methods tend to think first of survey methods like those found in "sociological" and "program evaluation" disciplines.

The current program of around twenty technology development projects resulted from competitive bids to a central funding agency. The period and scale of funding, was in the majority of cases, inadequate to take a project from design to completion. This dependency on future funding appears to have exaggerated certain roles for our "lessons learned" project. More than half of the twenty projects requested support and cooperation at the proposal development stage. Many of the projects have been slow to make their evaluation plans available in the semi-public CREDIT environment, although a handful of projects have regularly met to discuss their project and have kept and submitted meeting notes each week. Instruments and decisions have been carefully noted and the documents produced by this small group of projects will be used to determine the difficulty of retrieving "lessons" from these files.

The IDEA tool has been used as a resource centre for evaluation planning. Again, more than half of the twenty projects have made extended use of the evaluation planning guides and templates. General reflections on the value of these materials suggest that they are not yet in a form suitable for projects to use without additional face-to-face support. Early indications suggest these evaluation guidelines represent a profound shift of thinking from what instructors and developers understand about evaluation methods. Producing the on-line support helped condense the descriptions of protocols, but if the tools are to be used as independent support, they will need further development.

The "lessons learned" project will continue to work with the twenty or so projects in the program and will continue to develop the IDEA and CREDIT tools. After the experience of the initial eighteen months, we will likely spend more time in face-to-face interaction that we had originally planned.

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Continuous Improvement of Workflow Models Using an Explorative Learning Environment

Heimo H. Adelsberger, Frank X. Körner, Jan M. Pawlowski
Information Systems for Production and Operations Management
University of Essen, Germany.
{h.adelsberger|koerner|jan.pawlowski}@wi-inf.uni-essen.de

Abstract: Facing rapidly changing market conditions new requirements for information and communication technologies have arisen in the last years. This paper presents a new approach to integrate computer supported learning environments and workflow management systems to optimize workflows. The first step is the integration of learning processes into workflow models. This enables an easy development of explorative learning environments, particularly simulation games which are used to train users on basic and advanced levels. Solutions developed by the users are evaluated and transformed into process models which might improve current processes. The presented integration approach offers important synergy effects: a substantial improvement of the individual educational level, a new concept of employee participation, and an essential increase of continuous process improvement.

1 Introduction

The increasing relevance of flexibility and adaptability to rapidly changing market conditions leads to distinctive requirements for information and communication technology as well as for organizational concepts. In this paper we focus on the integration of Computer Supported Learning Environments (CSLE) and Workflow Management Systems (WfMS). Both are influenced by the requirements of continuous changes.

On the one hand, WfMS are affected because these systems manage and control the processes of value creation. Obviously, these processes have to be immediately adjusted according to required changes. On the other hand, it is essential to work with well-educated employees who are able to carry out both the current and modified processes. For this reason CSLE are so important. In previous work we have demonstrated the need of an integration of WfMS and CSLE (Adelsberger, Körner, Pawlowski, 98a, Adelsberger, Körner, Pawlowski, 98b). In this paper we introduce the idea of an integrative approach using simulation games for the optimization of adaptive workflows. We demonstrate the particular suitability of an explorative learning environment.

During the normal use of WfMS improvements are detected and realized during explicit (internal or external) projects. This procedure corresponds to adaptable processes or workflows in contrast to a continuous improvement. Integrating an explorative CSLE into the WfMS enables to continuously realize hidden optimization potentials exposed during the learning process using the real information system and real data. Thus, the integration approach offers two important advantages: an substantial improvement of the individual educational level and an essential increase of continuous process improvement.

After introducing the basics of WfMS and CSLE we present our approach of an integrated design of business and learning processes. Finally we describe the construction of an explorative CSLE within a WfMS and the potentials concerning the continuous optimization of workflow models.

2 Workflow Management Systems

The use of Workflow Management Systems (WfMS) improves the effectiveness of internal and external process management by realizing the process orientation, supported by modern information and communication technologies. The *Workflow Management Coalition (WfMC)* (Workflow Management Coalition, 96) defines a *WfMS* as "a system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications."

The presentation of tasks, the respective data, and applications to the users avoids competence conflicts and wrong document routing, and reduces the time to get into the new task. It is one of the important advantages of a WfMS that its Run-time behavior exactly matches the defined (and 'optimized') process models. Furthermore existing applications and information systems might be integrated into a WfMS. Among other things, this results in a standardized user interface and the avoidance of redundancies (Becker, Vogler, Österle, 98).

According to the Basic Model (Workflow Management Coalition, 96) the use of WfMS covers two main phases – the Build-time and the Run-time. Within the Build-time, i.e. the creation of the respective workflow models, different workflow types are created, checked, and administrated. During the Run-time control functions execute the workflows by interpreting these Build-time definitions and models. Accordingly, the models cover the following fundamental perspectives (Bussler, Jablonski, 96, Jablonski, 95):

Workflow execution means to carry out specific tasks according to the modeled manner. In this sense *Workflow Definitions* answer the question "What has to be done?" by defining (Build-time) re-usable workflow types. For the execution (Run-time) workflow instances are created. The definition of these types is hierarchical; elementary workflows (the lowest level) refer to Workflow Applications (see below).

To provide the right data at the right time, *Data and Data Flow Definitions* represent the data exchange between the workflows on all hierarchic levels. Control data and workflow relevant production data influence the workflow control and the selection of roles. In contrast, production data do not have any influence, as these are not managed by the WfMS.

Control Flow Definitions determine the order of workflows in a range between absolutely fixed to undetermined or unknown. (Khoshafian, Buckiewicz, 95) describe a corresponding workflow classification. Traditional programming constructs are used and combined to specify the control flows.

The *Workflow Application Definitions* specify interfaces and parameters to handle automated and manual applications. The functions and tasks themselves are not implemented in the WfMS but invoked by the WfMS.

Workflow instances are assigned to actors (human beings, machines, or information systems). Actors are described by resources with certain skills and competencies, influencing their participation in a role. The *Organization Definition* refers to the question "Who executes the workflow?" by evaluating the members of the required role.

All terminated, interrupted, and active workflow instances are recorded in the *Audit Trail*. Those data might be used to identify the actor of a specific operation, for recovery, and for the revision, analysis, and re-engineering.

To meet the increasing need for flexibility (Allweyer, Scheer, 95) formulated specific requirements for the creation of adaptive business processes to enable continuous process improvements without realizing a long-term and expensive Business Process Re-engineering project. They formulated requirements for adaptive business processes – requirements which are fundamentally fulfilled by WfMS.

The Build-time definitions (see above) and the recorded Run-time data (Audit Trail) offer a large potential to continuously adapt the workflows to changing needs. Nevertheless these potentials are seldom used for a continuous improvement. On the one hand, this might result from missing manpower or missing skills, because workflow models normally are created by external consultants. On the other hand, the users, apart from the traditional suggestion scheme, are not included in the improvement process.

By integrating explorative learning environments into WfMS we obtain a better participation of the users. Thus it is possible to expose and use hidden optimization potentials for a continuous workflow improvement.

3 Learning Environments

Due to the enormous amount of publications from a variety of research fields and perspectives the basic terminology of Computer Supported Learning Environments (CSLE) differs considerably.

Computer Assisted Learning (CAL) denotes the conceptual framework and methodologies as a base for learning, assisted by computers. Although the exact meaning might be interpreted slightly different several terms are used synonymously, e.g., Computer Supported Learning, Computer Assisted Instruction, Computer Based Education. Therefore, this term is the generalization of any concept and method of learning using information technologies.

A *Computer Supported Learning Environment (CSLE)* denotes the realization of CAL and its concepts and methods through information systems. The term CSLE therefore is a generalization for a wide range of instances and classes of instances of educational information systems (Adelsberger, Körner, Pawlowski, 98b).

According to (Kalkbrenner, 96) Computer Supported Learning Environments might be classified into five classes:

Drill & Practice Systems are based on the behavioristic learning approach. Learning contents are gradually presented, followed by repeated training assignments. Still being used on a regular base in practice this approach mainly serves for repeating or enhancing familiar learning contents.

Intelligent Tutoring Systems denote systems transferring knowledge specifically adapted to the level of an individual user. The human teacher is substituted by a computerized tutorial function guiding the learning process, answering questions, or evaluating the user.

Hypermedia Systems are used for the presentation of learning contents. Historically developed as a means for structuring text based documents by links and relations, recent developments integrate complex media formats, e.g., audio, video, and graphical elements.

Cognitive tools are "both mental and cognitive devices that support guide, and extend the thinking processes of learners." (Derry, 90) Therefore those systems support the learner's cognitive processes.

Simulation games provide a specific task or problem to the learner and a *micro world* for independently exploring and solving this task. The goal of the learning process is to acquire complex and interconnected learning contents. The teacher and/or the systems supports the user by coaching the learning process.

This paper deals with complex learning contents: business processes. Owing to its suitability for acquiring complex learning contents and complex thinking we concentrate on simulation games (Graf, 92, Schulmeister, 97). Furthermore our approach using the integrative development of WfMS and CSLE is particularly suitable for a cost effective and straightforward development of simulation games.

4 Integration of Business and Learning Processes

The following section is divided into two parts. First of all we describe the utilization of WfMS for the development of CSLE. Especially for the development of a simulation game the access to existing process models is essential. Therefore it is a prerequisite for the integration to add learning processes as an equivalent of business processes to the workflow models.

The second part deals with the generation of a simulation game as an example of an explorative learning environment. As a result of using the simulation game new and/or alternative solutions to the given task might be determined. These solutions contribute to the optimization of existing processes. The results are transformed into a workflow model which serves as a proposition for an improved process model. After that the proposition is evaluated and, in case of a positive evaluation, the process model will be updated.

4.1 Integration of Learning Processes into Workflow Models

Traditional WfMS concentrate on the co-ordination of workflows directly referring to the production of goods or services. They are mainly limited to the core business of the enterprise. Although learning processes, i.e. the acquisition of a specific skill, are a prerequisite for the successful execution and realization of workflows, process models rarely cover this important aspect. As a consequence the planning of basic as well as advanced training is mostly independent of the current demand of adequately skilled employees. Our integrated approach will eliminate this weakness, connecting learning and business processes in a common model.

Furthermore teaching and learning processes have to be integrated into existing models as a prerequisite for generating a learning environment to utilize existing applications, models, and data. A simplified example of those processes is shown in (Fig. 1) and (Fig. 2). Those models clarify the general steps of learning/teaching processes and the interfaces between components of CLSE and WfMS.

As a result of this integration the learner as well as the developer are enabled to work in their usual working environment (WfMS, applications). They can easily access the existing applications, models, and components.

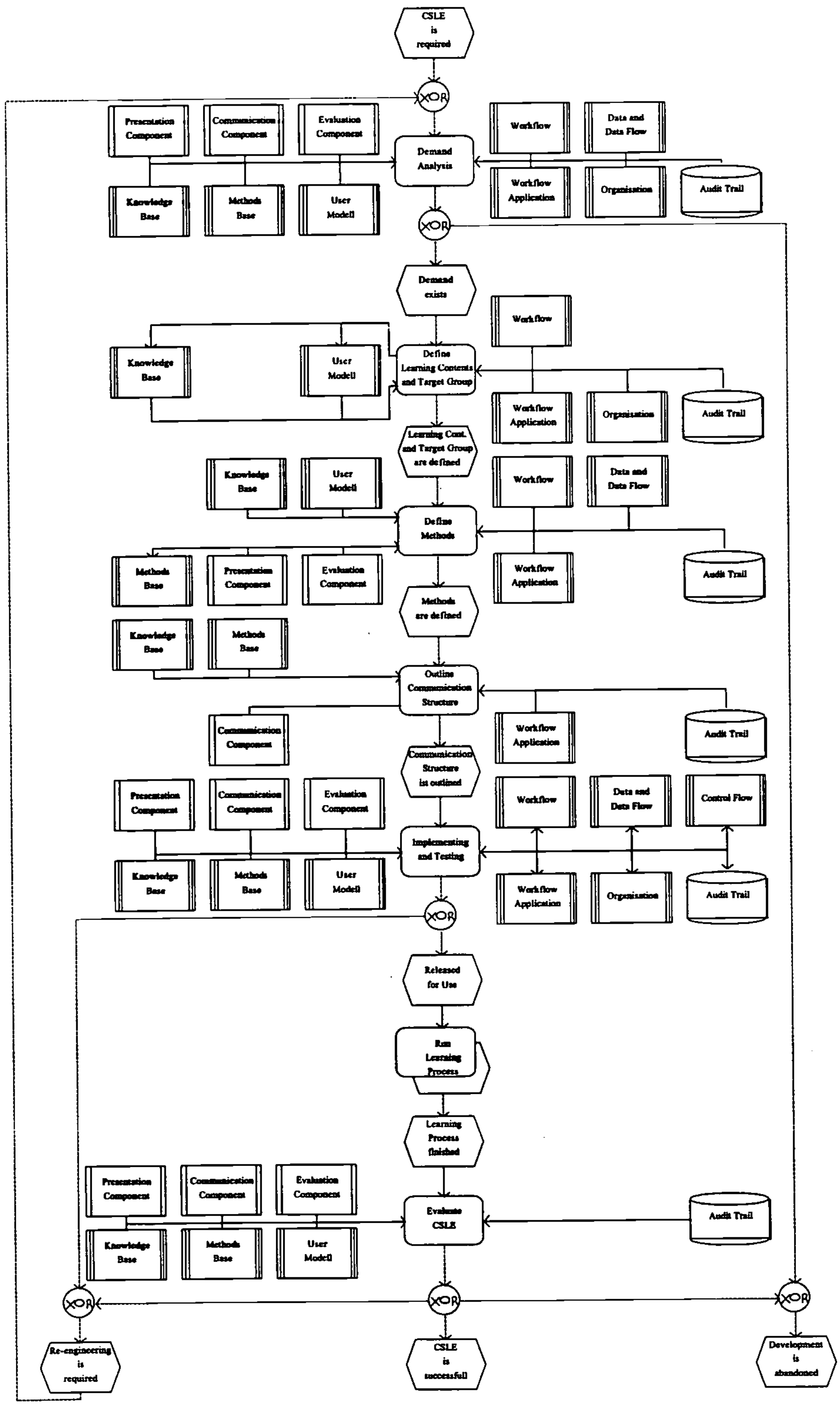

Fig. 1: Teaching Process

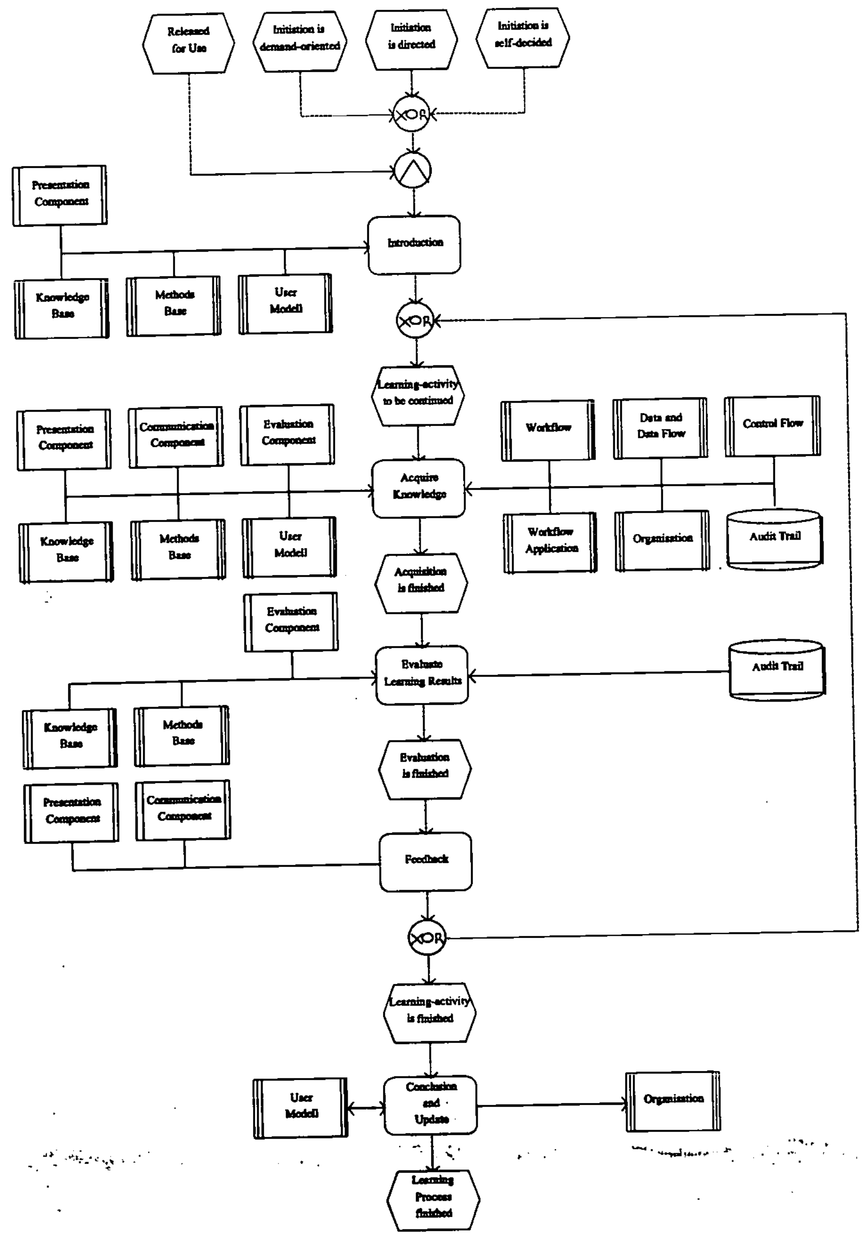

Fig. 2: Learning Process

4.2 **Optimization of Workflow Models using an Explorative Learning Environment**

This section deals with the generating of an explorative learning environment based on WfMS components. Furthermore we present ways how learning processes may contribute to the optimization of workflow models.

The *learning content* is the mastering of a specified task, available in the form of process models. Corporate processes are rather complex because of the multitude of participants, the problem structures, and the adequate use of several applications. Thus, a simulation game as an explorative learning method, is appropriate.

On the basis of the integrated design the development of simulation games – based on the WfMS – is possible without large expenditure. The learning environment consists of all applications, components, and the functionality of the real system. Obviously the learning environment cannot use sensitive data to ensure that the daily business is not influenced. The real history data recorded the Audit Trail are used as real but insensitive data for the learning environment.

The learner learns within a well-defined micro world. It consists of one or more sub-processes extracted from the process model. The interfaces to the related processes outside the micro world have to be defined. The corresponding data are exchanged with the related processes, either extracted from history data, or automatically calculated. Alternatively, an administrator or coach has to make available the interface data during Run-time.

Furthermore, several constraints have to be cancelled to enlarge the learner's scope. These constraints are defined/modeled in the real process model as control flows, data flows, or workflow applications. If the learner violates unavoidable rules, e.g., legal regulations, the learning environment must point to the consequences of this acting. The cancellation of constraints enlarges the scope of the learner, because his actions are not restricted by existing process definitions and the prescribed applications. The learner himself decides about the tools, applications, and manner to solve the problem.

During the learning process the learner produces results, i.e. data. These have to be evaluated making use of historic data to determine the learning success. Certain deviations in the results should be allowed within certain total tolerances. The learner can access the WfMS as specified in the model of the learning process. Thus, the actions and the use of available applications within the micro world are approximately unrestricted. The business processes and the learning process are both recorded in the audit trail.

The learning results have to be evaluated regarding several aspects: At first it has to be discovered whether the right data types have been modified. Furthermore the modified and generated data values must be within the total tolerances. If the realized results vary from the historic data because of significant process modifications the evaluation has to be checked by a human teacher. In addition individual evaluation criteria, e.g., the duration of the learning process compared to the real duration of the task have to be taken into account.

Besides, apart from the learner's evaluation, the recorded actions from the beginning to the problem solving are analyzed. This analysis serves as a basis for the transformation of the existing model to a modified one. During the transformation filtering (Fig. 4) redundant and non-productive learning steps are eliminated. The remaining steps are used to create the modified process model. The realized steps are modeled as workflows, the order of the steps influence the new control flows, and the actors involved are included in the organization definition. Afterwards the modified model is evaluated by use of process controlling ratios. In case the modified process should be better than the existing process an optimized model is suggested. The suggestion will be checked and, if positive, serves as a basis for the optimization process to update the actual process model.

In the following figures (Fig. 3) and (Fig. 4) the traditional isolated life-cycles of WfMS and CSLE are compared to the life-cycle of the integrated approach.

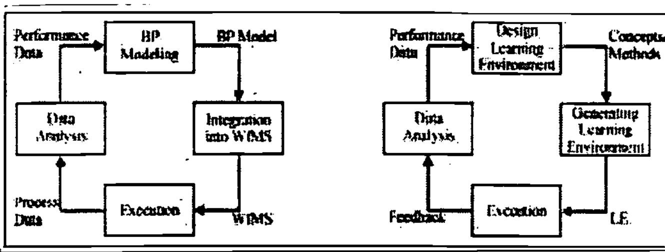

Fig. 3: **Isolated life-cycles of WfMS and CSLE**

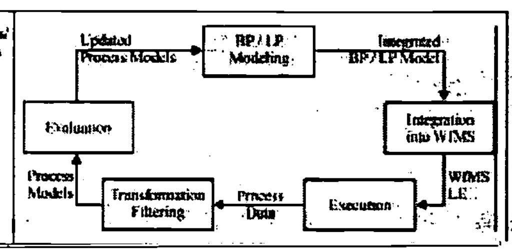

Fig. 4: **Integrated life-cycle of WfMS and CSLE**

The integrated approach offers substantial advantages compared to the isolated approach: The conception and implementation especially of explorative learning environments is not very complex. In addition the planning of the basic and advanced training is considerably simplified. Furthermore, the integrated approach may increase the motivation of the learners, because those learning processes that have been successfully completed may cause respective modifications and improvements in the daily business processes. Thus, there is the possibility that the employees actively and creatively take part in the design of their working environment and business processes.

Compared with the traditional suggestion scheme the integrated approach does not demand any additional work on behalf of the employees, because the creation of suggestions is integrated in the learning process. Besides the procedures of unprejudiced and neutral employees might be more creative than the procedures of employees having performed the processes for a long time.

5 Summary

In this contribution we described the integration of CSLE and WfMS using a simulation game for the optimization of workflow models. As a first step we presented an integrated modeling of business and learning processes. This integrated approach significantly decreases the effort to develop learning environments. As an additional benefit the planning of basic and advanced training is .

We presented the application of this approach, using a simulation game which can be easily developed basing on existing processes, applications, and training data of a WfMS. On the one hand, this method is particularly suitable for learning complex problems, e.g., the acquisition of knowledge concerning business processes. On the other hand, we achieved synergy effects for the optimization of business process and for motivational aspects. Even in the learning phase employees are involved in planning and improving business processes as well as their working environment. Compared to the traditional suggestion scheme this method of active participation will improve both the employee motivation and effectiveness.

The presented approach is implemented at the University of Essen as a prototype. During the next phase of our research activities we will evaluate the results by an empirical study. Furthermore we will investigate this approach from different perspectives, using varying learning methods and learning contents. This investigation will provide in-depths results concerning the suitability of the integrative development for specific requirements and fields of applications.

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Web Integration in Courses: Which Factors Significantly Motivate Faculty?

Tawni Hunt Ferrarini, Economics, Northern Michigan University, USA (tferrari@nmu.edu)

Sandra Poindexter, Business-CIS, Northern Michigan University, USA (spoindex@nmu.edu)

Abstract: University and college administrators intensely push for increased Web integration into lecture-based and other types of academic courses. As students' competencies with Internet usage increase they, too, demand educators to revise their educational methods. Some faculty members do move forward pedagogically in the age of high technology. However, some do not. Hence pedagogical and technological gaps between traditional and multi-media teaching methods appear. The general lauding of the Internet's educational benefits comes quickly, perhaps too quickly for the comfort of some in academe.

What motivates some faculty to use the Web to deliver and to display course materials as well as to provide lectures? Or conversely, what inhibits other faculty from doing so? By obtaining analyzed quantitative and qualitative data from faculty members from all disciplines this paper starts a cross-disciplinary study intended to answer these questions.

Introduction

Educators first utilized the Internet to communicate with fellow scholars and to gain access to remote research centers. Recently interest in the Internet and the World Wide Web (Web) becomes intensely more popular as use increases among individuals living in households and operating businesses. Riding on the coat tails of a non-academic wave of the Internet, educational applications can capitalize on the tools afforded by the Internet.

The Internet facilitates learning while increasing the number of educational opportunities for students. Introduced to the Internet in grades K-12, collegiate learners naturally utilize the Web and other Internet tools. This interest and proficiency coupled with the increase in computer ownership and access by students, means that the Internet can become a powerful educational tool in higher education. While the Internet *is* a significant tool that combines delivery medium with instructional content and course management, *effective use* requires careful consideration (McManus 1996). Universities should hesitate giving a Web mandate without this consideration.

Literature Review: Diffusion Patterns for Instructional Technology

Various diffusion models explain the pattern of user acceptance of a new technology over time in hopes of increasing the adoption rate (Brancheau & Wetherbe 1989) (Rogers 1995). A simplified "S" curve of Web integration (Fig. 1) based upon Roger's (1995) diffusion model illustrates that initially a small number of enthusiastic users pave the way for the next, but larger, generation of faculty adopters.

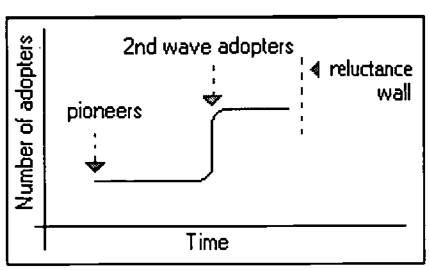

Figure 1. Diffusion Curve

Proficiency for the entry-level Internet integration occurs quickly within one semester instructors can include basic Internet options and establish student e-mail communication lines. Typically, the next step involves the creation of a Web site as a means of pulling the techniques together and managing them at a central location. The early pioneers had both the HTML skills and desire to experiment independently with Web integration, usually without administration incentives.

Some of the past primary drawbacks to extensive use of the Web in the curricula have been the time, effort, and HTML skills required of instructors (LeCroy 1997). Today, many universities employ instructional technology specialists who provide training and purchase Web course development software to speed the process of Web site development. These types of management actions overcome major hurdles and enable the large second wave of adoption—the vertical portion of the "S" curve. Shortly after this point in the diffusion process, the "reluctance wall" appears and the number of users remains fairly static, suggesting further management intervention is needed if additional adoption is to occur. References to these issues and software reviews are appearing in non-technical academic journals such as the Chronicle (McCollum 1997).

Current Study

At a selected regional liberal arts university of the researchers, this current study surveys faculty to identify: (1) this chosen university's pioneers and second wave Web adopters, the significant motivational factors that influence their Web use, and the hurdles they face(d) in using the Web; (2) the reasons other faculty do not use the Web (reluctance will not be treated derogatorily) and possible motivators for nonuse; (3) patterns in faculty demographics leading to adoption or non-adoption;

Findings

Of 179 faculty responses, three groups of self-reported Internet usage and one group of non-Net users emerged. The user groups are: (1) Current—use the Internet within existing courses; (2) Expected—plan to use the Internet in courses within the next academic; (3) year; (4) Non-User—do not plan to use the Internet within courses within the next academic year.

The demographics of the reported Net users indicate that 69 percent of the current users are tenured, and 25 percent are not. However when one compares what the "non-tenured" individuals are doing with the Net and Web to what the other faculty expect to do and what they do not expect to do, the percentage of non-tenured faculty actively using the Net and Web is slightly higher than the percentages of other two groups. This may dispel the belief that non-tenured faculty are not motivated to work on innovative teaching methods.

99 percent of the faculty responding to the surveyed maintain that they use the Net and Web for professional reasons daily. This may suggest that the all the survey participants are competent users. They are just not necessarily innovators and developers. 43 percent of the survey responders maintain that they do not use the Net and Web simply because they do not add anything to their currently effective styles of teaching. 39 percent of those interested feel that Internet specialists need to be hired to assist interested faculty. 36 percent are not educated on how the Net and Web can be used effectively in their classroom environments. Finally, 35 percent of the faculty maintain that they faced more formal incentives for spending time bettering their classes in traditional ways than for integrating the Net and Web into their classes.

A regression analysis was tested against these percentages to ensure they were not due to random chance. With the exception of "lack of university incentive", the t-statistics of all else is significant at a 90% confidence level. Holding all else constant, this suggests that NMU faculty decrease the number of Internet features used by roughly 1 if they do not find Internet and Web assessment tools useful [don't like e-assess] or do not know how to use these cybertools in their educational environments [applications]. They will decrease the number of Internet features used by roughly 2 if they find that their teaching styles are already effective [not teach style] or that they spend too much time in front of the computer [computer overuse]. NMU faculty would increase the number of Internet features used by roughly 2 if specialists were hired to assist or do the work for them [need specialist]. Lack of university incentive [no university incentive], though shown as 31-50% in the graph, proved not to be a valid statistical factor in determining Internet use within a course.

As might be predicted, current users have overcome many of the hurdles. The experienced group identifies three problem areas and appears more concerned about addressing these problems than the less experienced groups. These problem areas are: Experienced users now feel they spend too much time in front of a computer, that an Internet specialist is needed, and that there is a lack of technical support. Non-users need more information on Internet integration before they are apt to adopt this technology.

Motivating factors, shown in Fig. 2 for responding faculty currently using the Net and Web appear more proactive than reactive. The current users appear to be motivated by intrinsic pressures ranging from professionally driven motivation to desires to improve the quality of their courses, enhance communication with students, and disseminate course information and materials efficiently. Newer users appear reactive to pressures from administration, peers, and technological advancements. External motivators are all pressure points: from students, from marketplace, from peers, from technology, from administration. NOTE: it is possible the results would be different if the survey instrument had listed motivational factors rather than requested a written comment.

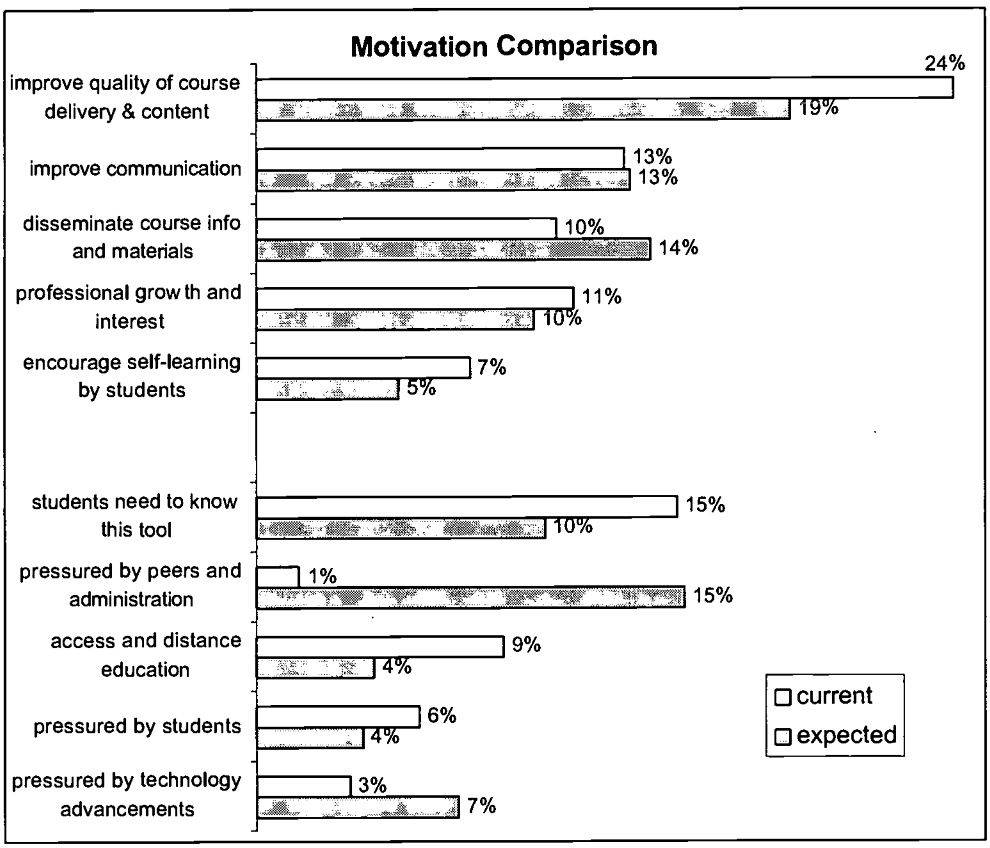

Figure 2. Faculty Motivators

Adoption Patterns

Based upon studies of how of innovations spread in their use, categories of adopters have been identified. The adoption, or diffusion, of an innovation typically takes the form of an S-shaped curve (Rogers 1995) (Cottrell 1997). The sample university's distribution of adoption follows this pattern; thus sample faculty can be considered "normal" in their approach to new ideas. The position and numbers of current adopters, and the expected 77 adopters within the next year indicate that a critical mass has been reached. A critical mass is the point at which a new idea has taken hold and, barring unforeseen circumstances, will eventually spread to almost all members of a group.

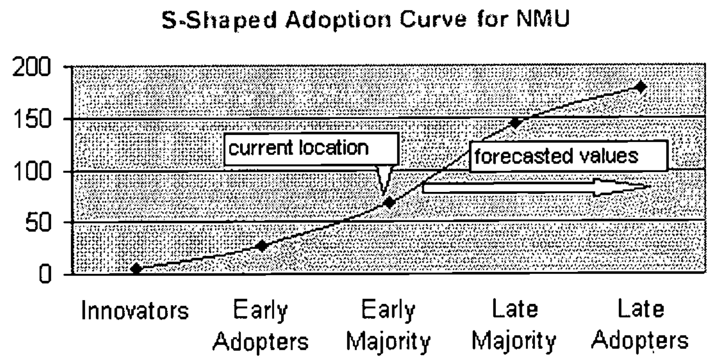

Figure 3: Adoption pattern at studied institution

Future Research

This study will be expanded to include numerous other universities. Internet and Web policy recommendations will be offered to university participants. Significant national trends may be identified as the national database expands and survey results are analyzed. Institutions interested in participating should contact the authors.

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EVALUATION OF A MULTIMEDIA WORKSHOP MODEL: TRAINING INSTRUCTORS TO USE TECHNOLOGY IN THE CLASSROOM

Patricia Ryaby Backer
Department of Technology
pabacker@email.sjsu.edu

Miriam Saltmarch
Department of Nutrition and Food Science
San Jose State University
San Jose, CA
saltmarc@inow.com

Abstract: This session will demonstrate the results of two years of summer workshops designed to teach K-12, community college, and CalState instructors how to use, and how to motivate students to use, multimedia and the WWW in their classrooms. The presenters will describe the training paradigm that was used with both groups of faculty: K-12 instructors and university professors. In both 1997 and 1998 there were disparities between participant and instructor expectations. The biggest problems lay in the initial lack of student understanding of the complex nature of multimedia design and execution, the amount of time needed to devote to the construction of even simple multimedia projects and the steepness of the learning curve for some multimedia tools. These training workshops were organized by the Mathematics And Science Teacher Education Program (MASTEP), a five year NSF sponsered consortium to improve mathematics and science in the greater San Francisco Bay Area.

Theoretical Framework

According to Fryatt (1995), the challenges of training teachers to use multimedia and to integrate multimedia and the WWW in their classrooms are not easy ones. In her review of the literature, she found that traditional in-service instruction in the use of technology is not effective because there is little active involvement, inadequate practice, and little or no follow up and support. Ferrier (1997), based upon his review of the current literature on effective adult learning strategies, believes that changes in teaching practice will happen only if professional development workshops: emphasize a commitment to try out new ideas in the classroom the next day, provide a supportive environment to discuss problems and solutions and report successes and failures, encourage participation in a wide variety of teaching and learning approaches, and reflect the needs of the school communities. Szabo and Schwarz (1997), in a study of three randomly drawn samples of 1000 full-time teachers in Alberta Canada, identified opinions of teachers that might influence them to make greater use of computers in their classes. When the teachers were asked who should use computers with students, 71 percent of the teachers responded " only those teachers interested in doing so." In addition, 99 percent of the teachers said that the ideal number of minutes per week of computer use by students should fall between 30 minutes and eight hours.

Models of Education

The focus of these summer MASTEP workshops was on training teachers to incorporate technology into their classrooms. Our focus (and mantra) was to encourage authentic uses of technology rather than traditional uses of technology. According to an Office of Educational Research and Improvement case study, reported by Barbara Means and Kerry Olson (1994), traditional uses of technology include: technology as a teachers presentation tool, technology for remedial instruction, and teaching students about technology. In contrast, authentic learning focuses on the student practicing advanced computer skills; in addition, these types of technology uses in education are generally collaborative with teachers as coaches and feature extended time for completing assignments. According to Singh and Means (1998), authentic uses of technology can have a significant impact as a catalyst for changing schools in ways that better support the acquisition of higher order skills. According to Brown, Collins, Duguid (1989), authentic or contextual learning increases the likelihood that students can apply what they learn in school to similar contexts.

The learning approaches emphasized by the summer MASTEP workshops were resource-based learning, collaborative learning, and project-related learning. As another study (Bos 1997) found, having K - 12 students create their own projects can serve several purposes within a science curriculum. Through WWW projects, student work can be enhanced and the authenticity of the work increased. According to Harrington and Oliver (1995, 1997), there are nine critical characteristics related to situated learning environments. The learning environment needs to: "provide an authentic context that reflects the way the knowledge will be used in real-life; provide authentic activities; provide access to expert performances and the modeling of processes; provide multiple roles and perspectives; support collaborative construction of knowledge; provide coaching and scaffolding at critical times; promote reflection to enable abstractions to be formed; promote articulation to enable tacit knowledge to be made explicit; and provide for integrated assessment of learning." (Harrington & Oliver 1995, 1997)

Results

Placement of the workshops in the institutional environment

The most successful attempts to equip faculty with the skills and knowledge, as well as equipment to create multimedia based learning materials, have occurred where there is a institution-wide effort; as demonstrated at Pennsylvania State University with Project Empower (Noel & Brannon 1997) and outlined in the TESSI Project adopted by the Ministry of Education in British Columbia (Woodrow et al. 1997). Unfortunately, not all higher education institutions or educational agencies have arrived at this juncture.

The MASTEP summer workshops permitted the initiation of the type of efforts carried out by Project Empower within a limited framework. Since these summer workshops could not provide the total framework of institutional support, as provided in Project Empower for faculty trying new technology, the challenges for both the workshop participants and instructors were greater. The difficulties for both participants and instructors as well as some of the compromises which had to made, can be instructive and helpful to other educators in educational institutions where a total institutional commitment to new technologies is not likely to made in the near future.

Summary of First year workshop

A summary of feedback from the initial workshops which included two one-week "basic" workshops and two three-week "advanced" workshops indicated that the participants felt that they received valuable information and that they were able to produce multimedia products during the workshop period. The participants who entered the workshop with a clear project idea were most able to take advantage of the instructional materials presented during the workshops and were also closest in their performance and outcome expectations to those of the workshop instructors.

The workshop instructors identified several areas of concern in their assessment of the workshop. These included a lack of appreciation by a significant number of the participants in the advanced workshops for the complex nature of multimedia software and hardware. In effect, these participants came into the advanced workshops with the expectation that they could create "plug and play" products with little effort on their part. These same participants were overwhelmed by the expectation during the workshop that they would actually have to create a multimedia product. They had trouble making the transition from passive learning ("chalk and talk") to active learning (participation and creation). Many faculty came into the workshop with the assumption that it would be a traditional "chalk and talk" even though they were informed before hand that they would be expected to design projects. For many students, the preconceived notion of a "chalk and talk" experience negatively impacted upon their ability to complete a project during the period of the workshop. In this finding, our results agree with previous research done by Oliver and Lake (1997) who found that students in an authentic learning environments found it took longer to learn by doing then to learn by lecture mode.

Many participants in the basic workshops did not have an awareness of the state of multimedia technology prior to the workshops. They would have benefited by having more time to be "brought into the technology" using an approach similar to that developed at Pennsylvania State University through the Project Empower program (Noel & Brannon 1997). In our course, as in the one by Oliver and Lake (1997), using technology seemed to hinder learning when technical problems arose.

Many of the participants in the advanced workshops also had trouble devoting enough time and energy to the workshops since they were not compensated in monetary terms nor were they assigned college or continuing education credit for attending the workshops except for the K-12 teachers. The higher education instructors from the state and community colleges were taking time from personal projects and other work projects in order to attend the workshops at cost to themselves. Because of these factors, attendance and attrition during the advanced workshops was a problem during the latter part of the workshop where participants did not receive formal instruction but were expected to work on individual projects. Some higher education instructors looked forward to release time during the next academic year to continue the multimedia projects developed during the summer workshops and these participants were more motivated to complete their projects.

Summary of second year workshop

June Higher Education Workshop

In all, fourteen faculty participated in the June 1998 workshop. The workshop was divided into four one week sessions. The first week focused on a pedagogical and philosophical introduction to the use of computers and education. Topics in the first week included an overview of various areas related to the use of multimedia and education. The specific content for this first week included the philosophy of using multimedia, teaching styles and their impact upon educational technology used in the classroom, using the WWW in your classroom, an overview of basic instructional models, story boarding ideas for multimedia, and copyright guidelines and issues. The first week ended with demonstrations and self paced tutorials of three authoring programs: PowerPoint, Hyperstudio, and Authorware.

The second week focused on the use of multimedia in the classroom and the third week on the use of the WWW in the classroom. These two topics were covered in separate weeks in order to provide more time to develop educational modules that maximized these different types of multimedia. The last week in the June session was spent on special projects.

Since these workshops were sponsored by MASTEP, the participants were surveyed by external evaluator. According to the evaluation summary, the participants indicated that the best aspects of this workshop were the emphasis and time for hands-on experience, the tutorials, the excellence of resources, and the staff technical knowledge. Additionally, most participants wrote that they could use what they learn in all courses they teach for creating presentations for classroom use.

The attendees of this workshop differed in many respects from the workshops of the previous year. Most of the faculty entered this session with highly defined, preconceived ideas of what they wanted to do. Sometimes, this led to a conflict between teacher and student expectations; incidentally, *this situation was not not reflected in the teaching evaluations that were excellent*. In many ways, students were resistant to any suggestion or teaching that did not fit into their paradigm regardless of the need of their design. For example, to engineering faculty members attended the June workshop with the goal of designing course Web pages. These faculty members refused to participate in any tutorials or class discussions, or learn any software , that was not directly related to their task at hand. Although this goal seems acceptable, this resistance precipitated the re-teaching of many concepts and software throughout the four weeks.

July K-12 Workshop

The July workshop session was structured differently than the June workshop in some respects. This session was again divided into four weeks. However, the fourth week had a different focus (the first three weeks of this workshop paralleled the content of the same weeks in the June workshop). The attendees of this workshop were all K - 12 teachers who had been selected to receive equipment and software through a proposal competition run by MASTEP. The teachers, by their own admission, expected that the workshops would follow a "chalk and talk" format. At first, the teachers were dismayed that they had to actively learn and produce tangible products. However, compliance to teacher expectations and motivation was high. Also, the students in this section were graded on the quality and appropriateness of their outcomes.

Comparison of 1997 and 1998

Length and focus of workshop

In 1997, the one-week "basic" workshops were well attended with little attrition during the week. These workshops were highly instructor-directed with a mixture of lectures and structured hands-on activities. There were simple step-by-step tutorials designed to give a brief introduction to various software packages. The "advanced" workshops in 1997 also initially had good attendance while the instructors were directing all activities during the first week in a similar format to that used for the "basic" workshop. However the number of individuals who enrolled for the "advanced" workshop was lower than for the "basic" workshop due to the three-week time commitment. During the second and third weeks of the "advanced" workshops, attendance was sporadic for many participants who were not fully committed to working the full workshop time on open-ended projects in spite of the available equipment and instructor expertise.

Based on the 1997 issues about attendance for the "advanced" workshops, it was decided in 1998 to shorten the workshops to one week modules. Two distinct groups of instructors were also identified and presented with separate workshop schedules and activities designed to address particular group needs. The two groups of instructors were 1) higher education instructors from community and state colleges and 2) K-12 teachers who had committed to being club advisors to science student clubs at their respective school sites.

For the higher education instructors, the workshops were divided into four consecutive one week sessions (discussed previously). The focus for each week was very specific with extensive resources and step by step tutorials provided to the participants and a project expected to be completed by the end of the four week period. All participants were expected to complete the first week but could choose which other weeks they wished to attend. These participants were not compensated monetarily but some community college instructors received college credit hours for the workshops.

For the K-12 club advisors, the focus of the workshops were also specific but the participants were expected to attend all four weeks of the workshops. These participants received college credit, monetary compensation and the promise of a multimedia station at their school sites upon successful completion of the workshops. The focus of these workshops addressed basic multimedia concepts and philosophy, use of multimedia and web tools and the design of multimedia student directed activities for the school sites. A key difference was that these K-12 teachers had to produce specific multimedia project outcomes in Weeks 2 and 3 and group-designed activities in week 4.

Compensation issues

It is not surprising to find that faculty, that are more vested in learning multimedia, produce more tangible outcomes. A continuing problem in providing multimedia workshops for faculty is the subsequent ability of the faculty to pursue multimedia on their own after the workshop ends. Since the K - 12 faculty in the 1998 section were given equipment as well as financial remuneration for their attendance and participation, there was more motivation for the K - 12 faculty to produce outcomes in the workshop. These unsurprising results was also found by Barnes (1997). In this study, project FIRST, activities and projects were developed by district teams consisting of a regular educator, a special education preservice teacher paired with a regular teacher for a year, and a university faculty member in special education. In addition, each team was loaned technology, both hardware and software, for classroom use for one year. Barnes found that, after six months, participants continued to integrate technology in their classrooms. The need for external reward also has been documented by Reiss (1998), in his analysis of project **T.E.A.C.H.** in the Camden school district, New Jersey.

In project **T.E.A.C.H.**, 48 of the original 50 teachers finished the training program and received a horizontal step raise. In subsequent years, the external motivation was that every teacher would receive a Macintosh computer for the classroom about halfway through the program. These computers would remain with the teachers, even if the teachers moved to other rooms or other schools in the district. Overall, as a result of this training, the Camden school district now has more than 250 **T.E.A.C.H.** graduates out of about 1750 teachers. More importantly, for most **T.E.A.C.H.** graduates, computers are used in the classroom on a daily basis.

Instructional pedagogy/philosophy

In the first year, the philosophy was integrated into the workshops in concert with the instruction about the multimedia tools. Although the first week was advertised as a beginning multimedia workshop, the instructors discovered that few faculty considered themselves to be beginners in technology. Therefore, about half of the faculty attending the "advanced" workshop did not attend the preceding "basic" workshop. This made it difficult to build upon skills taught in the first week. It also necessitated re-teaching of various techniques, philosophy, and multimedia tools in the second to third weeks of each session.

In both 1997 and 1998 there were disparities between participant and instructor expectations. The biggest problems lay in the initial lack of student understanding of the complex nature of multimedia design and execution, the amount of time needed to devote to the construction of even simple multimedia projects and the steepness of the learning curve for some multimedia tools. Many participants came in thinking that all they needed to do was to assemble ready-made pieces into a whole. There was resistance to the realization that each piece of a multimedia project has to be created.

Another expectation among the higher education instructors was that since they were not being compensated that they could pick and choose what they wanted to learn and to do regardless of instructor opinion and expectations. As discussed above, two participants in 1998 only wanted to create web pages and only worked on web pages with virtually no attention to the other multimedia possibilities or design considerations. The K-12 instructors were committed to (and extremely motivated by the level of renumeration) attending the four week workshop but did not initially understand the expectation that they would be expected to produce multimedia projects and that they would be graded on the results.

Use of multimedia tools

In the 1997 workshops, the participants were given brief tutorials covering various authoring software products as well as tutorials on how to incorporate audio, images and video segments. There was a great deal of latitude and one-on-one instruction with respect to other various software applications used to manipulate images, sound, animation, and video clips. Participants varied considerably in their relative technological sophistication and experienced some frustration with this approach.

For the 1998 workshops, the participants were provided with step-by-step tutorials for all software applications used in the workshops. There were specific applications (donated to the MASTEP project by Adobe Systems, Inc) used for image manipulation and creation, video capture, and editing. Three authoring application choices were offered for general multimedia projects and two web based authoring tools were offered for creating web pages. The participants, who had little familiarity with computers or multimedia applications, were satisfied when offered very specific instructions with limited choices in software applications.

Project outcomes

The seven multimedia projects produced for the 1997 "advanced" workshops were most complete and complex for the participants who took the workshops for college credit or who had well defined projects in mind before attending the workshops. In 1998, the higher education instructors completed two multimedia and two web projects during the workshop time but these projects varied considerably in the degree to which they incorporated multimedia design principles and features based on participant attitude and expectations.

For the K-12 instructors, the projects were consistent in level of use of multimedia design and use of features based on highly defined instructor instructions and expectations. These projects were generally more complex and complete than those created by the higher education instructors who were not compensated for their workshop participation. In week two, each K-12 instructor was required to design a interactive, non-tutorial, multimedia mini-lesson in math or science using Authorware or PowerPoint. In week three, the basic requirements for the mini-lesson were the same but the multimedia projects were designed using web tools (Adobe Pagemill was the only web authoring tool used in this session because this software was included in the equipment package they were to receive). In the fourth week, the participants were divided into collaborative pairs to devise eight student-centered learning activities for use in the math & science clubs.

Conclusions

Based on the experiences from these workshops conducted during the last two years there are both positive and negative implications for training instructors to use multimedia in their classrooms. From a positive standpoint, the level of motivation among faculty in general for improvement of their teaching was very high based upon workshop attendance by individuals who received no compensation. This fact is heartening based on the often expressed observation that faculty are rigid and disinterested in any improvement in their instructional methods. Another positive outcome of the workshop experience was the ability of technologically naïve (and fearful) individuals to produce fairly complex multimedia teaching mini-lessons in short period of time. From a negative standpoint, it is difficult to assure consistent instructor use of new technologies in the learning environment when there is not complete institutional support. These workshops were funded by NSF grant monies which are not an assured source of funding on an ongoing basis for regular instructional support within the institution.

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Using Design Experiments As a Means of Guiding Software Development

Steven McGee
NASA Classroom of the Future
Wheeling Jesuit University
316 Washington Avenue
Wheeling, WV, 26003
mcgee@cet.edu

Bruce C. Howard
NASA Classroom of the Future
Wheeling Jesuit University
316 Washington Avenue
Wheeling, WV, 26003
howard@cet.edu

Abstract: The following report illustrates how educational researchers and software developers can work in conjunction with teachers to optimize learning and provide an empirical basis for software revision. Using the Design Experiment Technique, teachers and researchers together determined, through successive classroom implementations, how to optimize the use of new software. Objective assessments made along the way indicated whether the curricular adjustments led to improved learning. The current research involved four implementations of software that teaches science content and inquiry skills. After each implementation, the data were analyzed, and classroom activities were revised. Revisions included the addition of time tables, the jigsaw method for doing background research, daily questions, and activity summaries. These revisions will also be incorporated into future versions of the software.

Introduction

User feedback is a central component of a successful software development project, whether the project is targeted for entertainment, self-help, or other commercial purpose. A primary consideration is ease of use, and developers customarily solicit impressions from users or observe users as they attempt to run the software. Developers of educational software, on the other hand, are interested not only in ease of use, but also in the impact the software will have on learning. Unfortunately, the difficulty of obtaining accurate user feedback on learning is complicated by the diversity of implementations teachers may use to integrate the software into their curricula. The research reported here illustrates how educational researchers and software developers can work in conjunction with teachers to optimize learning and provide an empirical basis for software revision.

The Design Experiment Technique is a recent advancement in educational research (McGee & Howard, 1998). Using this technique, teachers and researchers together determine how to optimize the use of new software through successive classroom implementations. For each implementation, there are objective measures that assess whether the curriculum adjustments have led to improved learning outcomes relative to the previous implementation. This technique was used by researchers at the NASA Classroom of the Future to evaluate the *Astronomy Village®: Investigating the Universe™* multimedia package. This paper will describe the design experiment process for four classroom implementations and how that process led to refinements.

Astronomy Village: Investigating the Universe

The NASA Classroom of the Future™ Program (COTF) is a NASA-funded research and development center that specializes in the development and testing of educational multimedia for math, science, and technology education. In March 1996, the COTF produced a CD-ROM called *Astronomy Village: Investigating the Universe* for use as a curriculum supplement in high school science classrooms. It was distributed to over 11,000 teachers, educators, and resource centers, and it won *Technology and Learning* magazine's Science Software of the Year Award for 1996. *Astronomy Village* uses the metaphor of living and working at a mountain-top observatory (the village) as the primary interface from which students investigate contemporary problems in astronomy (see Pompea and Blurton, 1995). Academic activities are designed to promote learning of astronomical concepts and processes related to scientific inquiry. Students join a research team and choose one of ten investigations to complete. In the Stellar Nursery investigation, for example, students investigate how stars are born. For each investigation, students progress through five phases: background research, data collection, data analysis, data interpretation, and presentation of results. For any given phase, there are from three to seven content-related activities to be completed before proceeding to another phase. The primary means of tracking progress through an investigation is the *Research Path Diagram*—a chart that displays icons representing activities within each phase. Each time a student clicks on one of the icons in the Research Path Diagram, a virtual mentor appears and describes activities relevant to that particular investigation. A second means of tracking progress is the electronic LogBook, in which students record their scientific notes and observations.

Method and Data Sources

The design experiment consisted of four one-semester studies. In each study students from one of two area schools visited the COTF facilities to use the *Astronomy Village* software.

Design Experiment Populations

The participating schools were from a rural community with a population of approximately 35,000. The demographics for each study varied (see Table 1). In the first study thirteen students from the ninth-grade class of a girls' academy (college preparatory) participated. In the second study nine students from the eighth-grade class of the same academy participated. In the third study twelve students from the tenth and eleventh grade of a large public high school participated. In the fourth study nine students from the eigth-grade class of the same girls' academy participated. Students from the third study were from an at-risk population. In each case students attended class daily for approximately four weeks at the COTF facility in lieu of their science class. Sessions using *Astronomy Village* were co-taught by the students' classroom teacher and the first author.

It should be noted that the students in Studies 2 and 4 were younger than students in Studies 1 and 3, and in Study 3 the population consisted of at-risk youth in a public school setting. Research predicts that the ninth-grade students from the college preparatory academy should have outperformed the other groups of students (those in lower grades and at-risk) (Blank and Gruebel, 1995).

Data Sources

There were three sources of data for this investigation. The first source was a compilation of documents in the students' electronic notebooks. In the first two studies students used the electronic notebook embedded within *Astronomy Village*. This notebook was called the LogBook. In the third and fourth studies, students used an electronic notebook called the Collaboratory Notebook as their LogBook. The Collaboratory Notebook was

	Study 1	**Study 2**	**Study 3**	**Study 4**
Time Frame	Apr-May, 1996	Oct-Nov, 1996	Mar-Apr, 1997	Oct-Nov, 1998
Num. of Students	13	9	12	9
Gender	All Female	All Female	F = 4; M = 8	All Female
Grade Level	9th	8th	10th-11th	8th
Type of Students	college prep	college prep	at-risk	college prep

Table 1: Demographics of Design Experiment Populations

developed as part of the Learning Through Collaborative Visualization Project (CoVis) Project at Northwestern University (Edelson and O'Neill, 1994). For each activity in *Astronomy Village*, students were expected to produce activity summaries in their LogBooks. These summaries consisted of a brief description of the activity, a statement of the importance of the activity in the context of the main research question, and any new questions that arose from the activity. The second source of data was videotapes of student interactions while using the software. The third source of data was field notes and classroom observations by the teachers and first author.

Dependent Measures

There were two aspects of the activity summaries that were considered for each design experiment. First, how many of the activities in *Astronomy Village* did students complete? Within each study the primary dependent measure for this question was an indicator of activity completion called the *activity completion rate*. This was an objective measure of the extent to which students were able to complete the assigned activities. Activity completion rate was defined as the number of activity summaries students completed, divided by the number of activities the mentor suggested. Second, were students able to relate the individual activities to the basic question for each investigation? In each study the primary dependent measure for this question was a measure of how closely the statement of importance within the activity summaries was linked to the overall investigation.

Design Experiment Results

In brief, the design experiment began by using the instructional procedures prescribed in the *Astronomy Village* package, and examining the effects as the program was implemented. Each succeeding study refined the procedures in order to achieve more effective outcomes. The next section describes each study and the impact of changes to the activity on the activity completion rate. Along with a description of each successive study, there is a discussion of how the instructional procedures were modified for the next implementation.

Activity Completion Rate

Study 1

In the first study the overall goal for the students was to complete all of the activities as suggested by the *Astronomy Village* virtual mentor. Our purpose was to implement the program as closely as possible to the intentions of the software designers. Students completed activities related to background research, data collection, data analysis, data interpretation, and presentation of results. As intended by the developers, students began by watching a videotape introduction to the software. Next, they worked within their project teams to complete a tutorial on using the software. After completing the tutorial, students proceeded to the virtual Conference Center in *Astronomy Village*, where the virtual mentors described the different investigations. The students selected different mentors and listened to a description of the research that each mentor was conducting. The students chose an investigation that interested them and joined an investigation team. Next, they accessed the Research Path Diagram, which introduced them to the resources on the *Astronomy Village* CD-ROM that related specifically to their investigation. By following the Research Path Diagram, students should have been able to complete the steps necessary to learn the appropriate concepts and conduct the level of problem solving needed for their investigation.

Completion Rate. Summary worksheets made activity completion easier, although completion rates were still below teacher expectations. The average activity completion rate for this study was 42%. This value indicated that over the four-week period, students completed less than half of the activities the mentor suggested. Further analysis of the activity completion rate within each phase of research (background research - 55%, data collection - 75%, data analysis - 35%, data interpretation - 20%, and presentation - 27%) revealed that the activity completion rate was much lower during later phases of research. This analysis of the activity completion indicated that the Research Path Diagram and virtual mentors were not sufficient to guide students through the complex problem solving required by the activities in the investigation. If students were not able to complete the activities in the investigation, it was believed they would not achieve the desired learning outcomes.

Study 2

In considering the disappointing performance of the students in Study 1, the teachers for Study 2 modified the implementation slightly from that intended by the designers of the *Astronomy Village.* The modification took three forms: *target dates* for phase completion, *more time* for activity completion, and *more contextualized training.*

Modifications. First, students were given target dates for each of the phases of research so they would have sufficient time to complete later phases of research. Second, teachers eliminated activities that did not seem to benefit the students. That is, the tutorial was eliminated, and students selected a investigation from a list of abstracts instead. These two changes resulted in approximately 17% more time for completion of activities (3.5 instructional days out of 20). Third, training was now given on an as-needed basis.

Completion Rate. The average activity completion rate for this study was 85%. This value indicated that over the four-week period, students completed twice as many activities as the students in the first study, even though these students were a year younger. The activity completion rate within each phase of research was as follows: background research - 78%, data collection - 100%, data analysis - 83%, data interpretation - 62%, and presentation - 100%. The students in this study had more opportunity to achieve the desired learning outcomes than students in the previous study. Thus, the use of an objective measure such as the activity completion rate made it possible to see what factors were preventing students from completing the activities.

Study 3 & 4

Although the modifications in Study 2 improved the completion rate, the teachers noticed that students were having difficulty seeing the connection between the individual activities and the investigation as whole. In Study 3, the researchers and teachers initiated several major modifications to help students see the connection. These modifications took three forms: all students working on the same investigation, the addition of a motivating question phase, and a shortened investigation structure.

Modifications. To help students complete their investigations more quickly, the research phases were revised and truncated. The new phases were the motivating-question phase, the background research phase, the background review phase, the data analysis phase, and the reflection phase. In the motivating-question phase the teacher posed the main investigation question, and the students individually typed responses in their LogBooks. Next, the teacher showed the students the data they would be analyzing and asked them to record observations. These two activities were meant to activate students' prior knowledge and connect it to the activities of the investigation. This approach was similar to Minstrell's benchmark lessons (Bruer, 1993). In the background research phase the teacher selected the three most relevant articles from the investigation, and each student read one of the three and developed an activity summary. In the background review phase students used their activity summaries to answer questions as a team, prompting themselves to integrate across the individual readings. Since each student was an expert on only one of the articles, students would be forced to discuss the readings with one another in order to answer the questions. In the data analysis phase students completed analysis worksheets as a team. And finally, in the reflection phase students responded to integrative, teacher-posed questions in their LogBooks. Using these redesigned research phases, it was possible to fit three investigations, rather than one, into the four-week period.

Completion Rate. The average activity completion rate for Study 3 was 74%. This rate was comparable to the activity completion rate from Study 2, even though the third group consisted of students who were at risk. The activity completion rate for each phase was as follows: motivating question - 82%, background research - 85%, background review - 62%, reflection - 73%. The activities for this study involved more explicit prompts for students to reflect on their background knowledge and relate that knowledge to the activities in the research investigation. These more explicit prompts increased the likelihood that students would assimilate the new information from *Astronomy Village* into existing knowledge structures.

Study 4 used the same structure as in Study 3, with one primary exception. The students only completed one investigation during an eight-day period. Also, researchers once again worked with eighth-grade students.

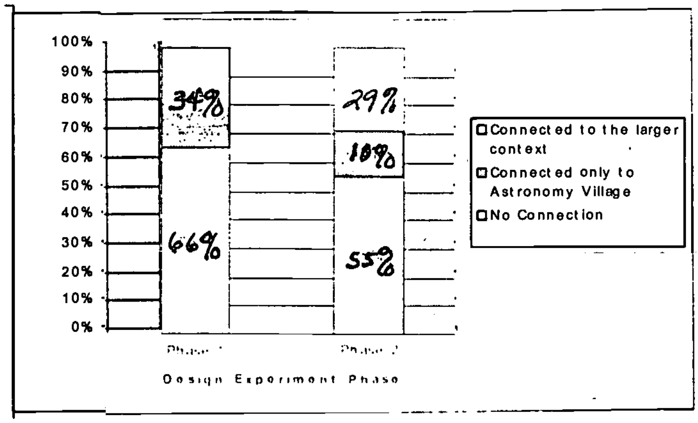

Figure 1. Percent of Activity Summaries that Relate to the Larger Context of the Basic Science Question

LogBook Quality

In addition to activity completion rates, researchers wanted to know how well students were connecting their activities over the four-week period to the larger context of the basic science question. (A basic science question addressed a fundamental issue in astronomy such as, Is there other life in the universe? In contrast, a research investigation question addressed a specific issue in astronomy such as, How do you determine what areas of the universe to examine for evidence of planets orbiting a distant star?) To evaluate these connections, the researchers examined students' LogBook responses to a particular question in the activity summary worksheets that queried the importance of the activity. A rating scale was developed to judge the responses. Responses that related the activity to a basic science question were rated more highly than those that merely related the activity to the research investigation question, while those that discussed only the activity itself (zero connection) were rated lowest. Statements of importance were extracted from the LogBook activity summaries for each article that students read. Raters were blind as to which study the statement of importance came from. Raters made judgments by comparing the statements of importance to the article content, the investigation research question, and the basic science question.

Researchers investigated the impact that the various implementations had on the quality of the LogBook entries. In order to simplify the analysis, the studies were clustered into 2 phases, based on the similarities of the implementations. Phase 1 encompassed Studies 1 & 2, in which students worked on one investigation *at their own pace* over four weeks. Phase 2 encompassed Studies 3 & 4, in which students worked on several investigations-- as directed by the teacher-- and used a truncated set of activities for each investigation. In addition, Phase 2 studies were more explicit in providing students with assistance in making connections between activities.

Results indicated that students from Phase 2 studies were able to connect almost one-third of the activity summaries to the basic science question for each investigation (see Figure 1). In contrast, students from Phase 1 studies were able to connect roughly one-third of their activity summaries *only* to the research investigation question. The two phases were comparable in the percent of activities that contained no connection between the articles and the research investigation or basic science question. A Chi-square analysis indicated that the higher percentage of students in Phase 2 who were capable of connecting the activity summaries to the larger science context was statistically significant ($\chi^2 = 12.19, p < .01$).

These results indicated that the addition of a motivating-question phase and a reflection phase helped the students to draw connections between the various activities within the extended project. By making explicit references to the basic science question and prompting students to develop hypotheses about the basic science question, the teachers in Phase 2 helped students connect individual activities to the larger scientific context.

Conclusions

The specific modifications in this design experiment were unique to the *Astronomy Village* software and to the particular classroom setting used at COTF. However, the general issues that were revealed are germane to many software programs and classroom contexts. If teachers understand the issues they will face while implementing technology and are given guidance on how to address these issues, there will be a greater chance that educational reform will be sustained beyond the initial pilot projects (McGee & Howard, 1998).

The results of the design experiment helped the developers at the COTF understand the kinds of supports that would be needed to optimize learning. These supports are now being incorporated into a new version of *Astronomy Village* that will focus on the solar system. In this new version the investigations will be shortened to one week to help students better manage their time. With more time, students will have four opportunities to conduct investigations in a four-week period. To help students connect individual activities to the investigation question, an exploration phase will also be added, to take place prior to the background research phase. The exploration phase will serve the purpose of the motivating question phase in Study 3. In addition, the LogBook will provide structured prompts (similar to the activity summaries) to help students reflect on the learning process.

Reform will only take place when teachers are able to explore the implications of a new curriculum within the context of their own classrooms. That an educational multimedia program was used successfully in a one school district does not necessarily mean that it will be effective in another. Design experiments can be especially powerful when results lead to teacher-generated design principles. Creating partnerships between teachers and researchers will enhance reform by giving teachers tools for evaluating their own implementations and providing researchers a means of comparing implementations across different contexts.

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User Interface Issues for Telepresentations *

Wolfgang Hürst
Institut für Informatik, Universität Freiburg, Germany
Email: huerst@informatik.uni-freiburg.de

Abstract: Common paradigms for human-computer interaction used in the design of general computer interfaces are often not suited for the telepresentation scenario. This is true for hardware input devices, generally keyboard and mouse, as well as for software user interfaces. The use of alternative input devices and the adaption of the according software is necessary to gain full profit of the augmented possibilities computer supported presentations can offer. In this paper we will present different hardware devices and discuss their usability for telepresentations. Various experiments carried out in miscellaneous lectures at our university indicated numerous problems and requirements for the hardware and software. We will present our experiences, discuss the occurring problems as well as possible solutions, and address current and future research areas.

Introduction

Telepresentations, i.e. presentations given with the use of computers, offer great advantages and augmented possibilities compared to regular talks. The additional functionalities can be useful to improve the presentation and to support the person giving a talk. Multimedia supplements facilitate the understanding of complex facts and offer new insights into difficult problems. Online transmission and recording for offline use can be done with a high quality at low costs. Time and space independence can be achieved through these recording and transmission facilities. However, the tools and devices which are generally utilized for such a telepresentation require additional training and customization before they can be used in a gainful way. Common computer interfaces are not designed to give presentations but to operate regular computer programs, such as wordprocessing systems, databases, web browsers, and so on. In the telepresentation scenario these interfaces normally lack required functionalities and force the lecturer to adapt to an interface which is not suitable for the respective needs. In this paper we will address the user interface issues for the teleteaching scenario. We will have a closer look on what the needs are, we discuss alternative input devices, how they can be applied in telelectures, and the consequences for the design of user interface software.

Telepresentations and Ubiquitous Computing

In the presentation and teleteaching scenario a computer in combination with a data projector is generally used as a replacement for traditional presentation facilities, i.e. chalk and blackboards or slides and overhead projections. The screen of the computer running a so-called *electronic whiteboard* program is projected on the wall with a data projector and transmitted over the network to the stations receiving the talk. The presentation is given at the computer interface with the use of common input devices, i.e. keyboard and mouse. Many whiteboards contain connectability to the internet and transmission facilities. Some of them, such as the *AOFwb* [4] developed in our group, also have integrated recording features.

One problem with this approach is that the whole presentation has to be given on a computer interface. This is not the common environment for giving a talk and is especially a problem if the lecturer is not used to work with computers. Common electronic whiteboards have interfaces which can be handled easily by people who work with computers in their everyday life but are not suited if the lecturer has limited experience with common user interface paradigms. The lecturer also has to sit in front of a computer. This might result in a lack of social contact with the local participants of the presentation. Ideally the user interface in the teleteaching scenario should be intuitive and

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no special training should be required for new users. The presenter should be able to concentrate completely on the content of the talk and not on the operation of the teleteaching interfaces. No restrictions should apply to a lecturer about which presentation techniques to use. The new tools and interfaces should be able to be operated in the same manner as the traditional ones which would be used if the presentation had been given without computers.
An interesting aspect in this context is the concept of *ubiquitous computing* introduced by M. Weiser [9]. Ubiquitous computing is "the method of enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user" [10]. Computers are integrated into our everyday environment in a way that we can interact with them without realizing them. Therefore we are able to gain from the augmented possibilities offered by the computers without even having to think about their existance. In this way the computer becomes invisible to the user. To apply the ideas of ubiquitous computing to the teleteaching scenario we need tools similar to a blackboard or an overhead projector that are also able to perform additional tasks, such as easy transmission and recording or the use of multimedia supplements. Electronic whiteboards could be used for this purpose but require adaption of the hardware interface used for human-computer interaction on one hand and of the software interface on the other hand. In the next section we will discuss the resulting hardware issues.

Hardware User Interface Issues

Experiments with Different Hardware Input Devices

As discussed in the previous section, there is a need for hardware devices which replace blackboards and overhead projectors in regular classrooms. Therefore we require a wall mounted interactive board and a touch sensitive device on a high desk in combination with a data projector. They should be similar to handle by a user like the respective facilities they are replacing. Additionally they should offer full access to the software interfaces providing the supplementary features which make telepresentations such a useful and exciting area.
A relevant overview on user interface hardware currently available on the market can be found at the Web page provided by B. Buxton at [2]. Several of these hardware devices can be used as an interactive board to replace a wall mounted *blackboard*. In our tests we used two large digitizing boards (see Fig. 1, left and middle). They are touch sensitive and send the coordinates of every position that a person contacts, either by hand or by the use of another tool, e.g., a pen, to a connected computer. If the content of the computer screen is projected on the board, then the mouse pointer can be moved and mouse clicks can be executed just by touching the board. This facility can therefore be used to operate an electronic whiteboard. The behavior of the board is similar to a touchscreen mounted on a regular desktop computer. In the board shown at the left side of Fig. 1 the computer content is projected on the board from a data projector standing in front of the board. The one shown in the middle of Fig. 1 has a rear projection system where the data projector is placed behind a transparent input area. This circumvents the problem of covering parts of the board with your own shadow while standing in front of it. It turned out that in combination with an electronic whiteboard, e.g., the *AOFwb* [4], such a board is very suitable as a blackboard replacement. Both the lecturer and the students attending the talks locally found it a pleasant and convenient tool. However, several problems occurred which will be discussed in the next paragraph. One problem was the limited size of the board. The boards used in our experiments had a diagonal screen size of 58 1/4" (148 cm) and of 72" (182.9 cm). In large rooms this might be to small to provide reasonable input and output facilities for a regular talk or presentation. Even the largest board available on the market today seems to be to small for our purpose. One possibility to circumvent this problem is to take two or three of these boards and put them next to each other to get a wide interactive blackboard, such as it is done by the Integrated Publication and Information Systems Institute, IPSI, at the German National Research Center for Information Technology, GMD. They connect three boards, each having a diagonal screen size of 72" (182.9 cm), to form one large interactive wall, called the *DynaWall* [8]. The connection of more boards next to each other poses new requirements on the interface design and the implementation of the underlying programs which we will address later.
There are also some input devices on the market useful (in combination with a data projector) as a replacement for *overhead projection systems*. We tested a regular computer screen equipped with a touchsensitive display. An electronic whiteboard runs on the connected computer and can be operated by the user with the fingertip or a pen like facility. The display should be mounted horizontally to resemble writing on a piece of paper or a slide lying on an overhead projector. The content of the interactive computer screen is projected on the wall with a data projector. We tested regular touchscreens and found out that they are not reasonable for our purpose because they

Figure 1: Hardware used in our experiments: interactive boards (left and middle) and graphic tablet (right).

usually react to every kind of input performed on the display. Therefore it is, for example, not possible to rest your wrist on the surface when writing with a pen. Freehand-writing on a horizontally mounted display equipped with such a touchscreen is only possible by radically changing your regular writing style. This is not acceptable in our scenario. However, there are a few hardware devices commercially available which use special techniques only recognizing input from a particular tool, such as a special pen, but not from other facilities, such as the users hand. However, most of them lack a size appropriate for our purpose. This is the reason why we used a regular graphic tablet for our experiments, such as the one shown in Fig. 1 (right). Here the input is done on the writing surface of the graphic tablet with the use of a special pen recognizable by the tablets hardware. Every other kind of input, e.g., touching the tablet with the hand, is rejected from the hardware. The output is indicated only on the computer screen, but not on the graphic tablet. With this technique our electronic whiteboard can be operated remotely using a pen instead of a mouse. The principle of this kind of operation is the same as using a regular computer mouse but allows easier writing and freehand drawing for the lecturer. Due to the separation of input and output area, this kind of interface requires some time to get used to it. Our experiments indicated that some people found it a very useful tool for telepresentations while others did not feel comfortable with this kind of "remote writing". Therefore, with some training and in combination with a data projector, such a graphic tablet can be used as an alternative input device and a replacement for classical overhead projection systems. However, it is not a perfect solution. Another problem resulting from this setup is that the lecturer is still sitting or standing in front of a large computer screen which might block the view to the local attendants. The students felt this loss of eye contact as a disturbing factor during our experiments.

Problems, Consequences, and Requirements

The used input devices for our teleteaching scenario should act as reasonable replacements for traditional representation tools, such as blackboards and overhead projectors. The various experiments and real-world tests that we did during miscellaneous lectures and classes with the devices introduced in the previous section pointed out several consequences and requirements the new hardware interfaces should fulfill:

- An input device similar to a pen or a chalk should be supported. Additional input facilities, such as a keyboard, might be desirable in special situations.
- The input area should be identical to the output area. Remote input and control of the electronic whiteboard is not appropriate because it requires special training and an adaption to the interface. In our scenario this is not an intuitive way to interact with the application program(s).
- "Input by accident" should be avoided. For example, resting your hand on the input area while writing with a pen should not be misinterpreted as any kind of input.
- The input and the output area should provide an appropriate size, i.e., they have to have about the size of a regular blackboard or overhead projection. The presentations have to be large enough to be readable by the local attendants and large enough that an appropriate input by the lecturer can be guaranteed.
- The resolution and the sensitivity of the screens replacing the blackboard or the projector have to be adequate.

- The surface has to provide good reading and writing. For example, no reflections should disturb the audience or the lecturer and no concavity should complicate the input.
- There should be no need to darken the room, because dark rooms are not acceptable for the local attendants.
- The use of special hardware should not block the attendant's view of the lecturer or to the board. Eye contact between the person giving the talk and the audience is important.

These basic requirements resulted from the experiments we did with special hardware facilities. However, the list given here generally applies to every kind of input interface. Further problems and requirements we identified are due to the design of the software interface and will be discussed in the next section.

Software User Interface Issues

Experiments with Standard Graphical User Interfaces

The software design of an appropriate user interface has to meet the requirements resulting from the different input devices and the ubiquitous computing scenario. In stressful situations, such as giving a talk, people tend to have wrong input behavior or to get confused by the interface more often. They are concentrated on their presentation and not on the interaction with the computer hardware. Therefore the interface should be easy and intuitive to handle.

For the experiments with the alternative input devices discussed in the last section we used our electronic whiteboard, the *AOFwb* [4]. The interface of this whiteboard is comparable to regular computer interfaces found in programs with similar tasks. No special adaption of the software to the new hardware facilities has been done. A screenshot of the *AOFwb* interface can be found in Fig. 2.

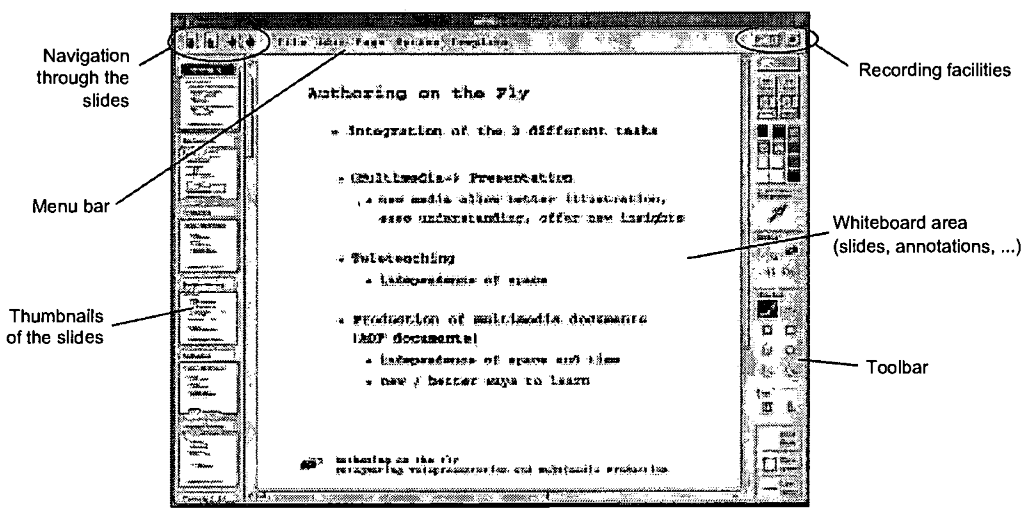

Figure 2: The interface of the electronic whiteboard *AOFwb*.

This is a typical Graphical User Interface (GUI) found in many similar computer programs. These interfaces, sometimes also called WIMP (*W*indows, *I*cons, *M*enus, *P*ointing) interfaces, follow the desktop paradigm. They have been designed for the use with desktop computers for tasks such as word processing, database management, and so on, but not to interact with large interactive walls. Our experiments showed that even users experienced with such common human-computer interfaces have problems in operating them during a telepresentation. We discuss these issues in the next paragraph.

Problems, Consequences, and Requirements

Typical Graphical User Interfaces, such as the one used in the *AOFwb*, have been designed to be used on desktop computers. They are not suited for the operation of large interactive walls. Various modifications have to be applied. For example, with the remote operation using a regular computer mouse, navigation through nested menus seems to be a reasonable way to interact with a desktop computer and to execute commands. When standing in front of an interactive board using a pen as input device, pressing just a single button seems to be more appropriate. The desktop paradigm has to be replaced by a "blackboard paradigm". The different size of the interaction devices also has to be considered in the interface design. Regular computer programs usually place things like a toolbar on one side of the interface. This is an appropriate solution for the screen of a desktop computer, but causes problems on a large scaled interactive board because the user always has to walk to the specific position where the toolbar is placed. Ideally the toolbar should be accessible from anywhere the lecturer is standing. "Popup toolbars" might be a solution for this problem. Another approach can be found in [7]. Here an additional palm top computer is used to hold the toolbar. It can be carried by the lecturer in his/her none-dominant hand and is connected to an interactive board via a wireless connection.

Another problem is that it is hard to remember which tool is activated at a particular time. Similar to the use of a computer mouse, the finger or pen of a user has a different functionality depending on which tool is selected. Regular whiteboards or graphic programs usually indicate the currently selected tool by highlighting the according icon on the toolbar and by displaying the mouse pointer as a symbol indicating the functionality of the selected tool. These software solutions do not work well with interactive boards. Due to the direct interaction with the board, no remotely controlled pointer is required. Indication of an icon representing the current tool is usually only possible at the last position of the board that was touched by a user because the hardware normally only recognizes if a board is touched, not if the pen is moved without touching it. The indication of the selected tool at a particular place on the board still requires that one looks at this position before whiteboard actions are performed. The question rises whether it is reasonable to assign more than one functionality to the same input device if the operation is done directly instead of remotely. Some boards offer hardware based solutions to this problem. For example, the board that we used comes with an integrated pen tray holding several pens in different colors and a sponge. Sensors capture the tool which was picked up at last. Each contact with the board is now interpreted as the board is touched with this tool. This method can also cause problems, for example, if the user picks up more than one tool at a time or forgets to put a tool back to its place. In our experiments we discovered that such mistakes happen especially often if the board is used under stressful situations such as giving a talk. Furthermore, such a hardware oriented solution is not particularly flexible and thus not open to further modifications and extensions as a software based one. An interesting approach in this context is work done by the Integrated Publication and Information Systems Institute, IPSI, at the German National Research Center for Information Technology, GMD, and a group at the Xerox Palo Alto Research Center. Contrary to the traditional approach of first selecting a tool and then using it, they recognize gestures that represent different functions. Therefore operations such as moving of objects or the reorganization of tables can be done without the need to activate a special tool. Additional information on their work can be found in [3] and [5, 6].

The question of what functions should be offered to a user must also be addressed. The toolbar on our whiteboard has a variety of different functions, while the *ZenPad* [1] used in the classroom 2000 project at Georgia Tech offers only a few ones. Their reason for offering only some essential tools to the user is that they determined that most of the lecturers which utilized their whiteboard only used few of them. We experienced the same results when external lecturers used our whiteboard. An increasing number of options also reduces the manageability. However, we also discovered that people who are familiar with our whiteboard tend to utilize more of the additional tools we offer. Based on this fact, we believe that there is a demand for these functionalities. So on one hand high functionality discourages and confuses potential users. On the other hand reducing the functionality experienced users might want or need does not seem to be an appropriate solution. One good compromise we are working on right now is to make the toolbar customizable by the user. A "low level" user interface should only offer the basic functionality needed to give a presentation. Based on his/her own needs and experience, the lecturer can decide what features are necessary and still can be handled during a special presentation and add them to the configurable toolbar.

In our experiments we used either the interactive board or the graphic tablet, not both in common. In an ideal scenario one would like to have a wall mounted blackboard as well as an interactive high desk functioning simultaneously. The lecturer could then walk around and switch between the two input devices during the presentation depending on his/her personal aims. However, due to the use of more than one interface at a time the software has to handle the communications between both. No inconsistency should result from the use of different input devices. Even if both hardware devices, the interactive board and the high desk, are controlled by the same computer several problems have to be solved. Most of the common operation systems permit connections with more than one screen to a computer. However, it might be irregular for one program to run on both screens. Copying of an object from one screen to another is generally also not possible. This task is especially necessary if you put more boards next to each other to form a large interactive wall. Therefore appropriate network connections and protocols have to be established that allow such operations without the loss of consistency. Work in this area has been done by [8] and [7].

Finally the question has to be answered of how the content presented on these interfaces during a talk should be indicated on a receiver station during transmission or at a local desktop computer during offline viewing. The relationship between the hight and the width of the input devices we used were about the same as with regular computer displays. As we already mentioned, a larger size, especially concerning the width of the interactive blackboard, is desirable. Therefore intelligent representation techniques must be introduced that handle the conflicts resulting from the different size of the input devices used by the lecturer and the output devices used by the remote attendants or the viewers of recorded talks. As well, the integration of back channels for feedback from the audience placed at the remote channels has to be done in an appropriate way.

Summary

In the preceding sections we discussed some hardware and software issues on new user interfaces within the scope of telepresentations and teleteaching. We introduced discoveries which we gained with two alternative input devices: interactive wall mounted blackboards and a graphic tablet as replacements for regular computer input via mouse or keyboard. Our experiments and analysis showed that input devices currently available on the market can be used very well for teleteaching but somehow still are a compromise and lack especially in the provided size. We also illustrated that the use of these input devices raises new problems and offers additional challenges in the software design of the user interface. Our current work is to implement a new user interface that addresses the problems we discussed and to test and evaluate it with other hardware devices we are about to install in the teleteaching environment at our university.

Acknowledgements

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DoCTA: Design and Use of Collaborative Telelearning Artefacts

Barbara Wasson & Anders Mørch
Department of Information Science, University of Bergen, N-5020 Bergen, NORWAY
Email: Barbara.Wasson@ifi.uib.no Anders.Morch@ifi.uib.no

Abstract: Project DoCTA focuses on the design and use of artefacts in a set of collaborative telelearning scenarios. From a research perspective, the exploratory studies being carried out within DoCTA will provide us with insight into the processes of collaboration enabling us to identify collaboration patterns and further our understanding of how instructors, students and other learning facilitators organise their learning and work. This paper describes the theoretical foundations, the four collaborative telelearning scenarios and the evaluation approach of project DoCTA.

1 Introduction

DoCTA (Design and use of Collaborative Telelearning Artefacts) is a Norwegian research project with partners at four different institutions and funded by the Norwegian Ministry of Education, Research and Church Affairs under their program on information technology in education (ITU). The project partners include is the University of Bergen (leader), Nord-Trøndelag College (HiNT), Stord/Haugesund College (Stord) and Telenor Research and Development, Kjeller (Telenor FOU). The 16 researchers and graduate students involved have various backgrounds including computer science, psychology, sociology and education.

Within project DoCTA (http://www.ifi.uib.no/docta) we focus on the design and use of artefacts in collaborative telelearning scenarios aimed at teacher training. Various scenarios utilising the Internet will be used to engage the students in collaborative learning activities. Through participation, teachers gain experience with not only collaborative learning, but with collaborative telelearning, and the design of textual or visual artefacts. Each collaborative learning activity has been designed to place a strong emphasis on active engagement through both "hands-on" practical experience and explicit reflection on the collaboration process. Experiences can be transferred back to their own schools, and ideas about collaboration can be integrated into their everyday teaching.

Four different collaborative telelearning are studied. The first scenario, PedInfo, is a pilot study for analysing the use of TeamWave Workplace for collaborative activities in a graduate university course at the University of Bergen (UiB). The next two scenarios, IDEELS and Demeter, involve European inter-cultural simulations where the goal is to design a textual artefact (such as a treaty or policy statement). A fourth scenario, VisArt, that has been designed and developed explicitly for use between the three educational partners (UiB, HiNT and Stord), has the goal of designing a visual artefact to be used in teaching a subject of choice.

From a research perspective, the exploratory study being carried out within DOCTA will provide us with insight into the processes of collaboration enabling us to identify collaboration patterns and further our understanding of how instructors, students and other learning facilitators organise their learning and work. The community of study includes teachers, learners and facilitators participating in the various collaborative telelearning scenarios. The main research question has been formulated to ask how these students, teachers and facilitators organise their work given the different scenarios. The four collaborative telelearning scenarios vary with respect to:

- actor characteristics (e.g., within a common community vs. disparate and divergent cultural backgrounds; similar knowledge and preparation vs. different knowledge and preparation; etc.),
- aspects of the learning activity (e.g., text based vs. visually based; well-defined learning tasks and goals vs. ill-structured tasks and goals; etc.),
- the kinds of artefacts they have access to (e.g., the artefacts provided in the various internet environments), and
- the kinds of artefacts they are to design (e.g., textual or visual)

This paper provides an overview of the theoretical foundations that influence our research and describes each of the four collaborative telelearning scenarios. The paper concludes with a brief description of the evaluation activities being carried out.

2 Theoretical Foundations

The theoretical perspectives that provide inspiration and guidance for this research come from: computer supported collaborative learning (CSCL), in particular Salomon's (1992) work on genuine interdependence; coordination science (Malone & Crowston, 1994); sociocultural perspectives (Wertsch, del Río & Alvarez, 1995) on learning and thinking; and, the emerging notion of distributed learning communities.

Computer supported collaborative learning (CSCL) is an emerging paradigm (Koschmann, 1996) for research in educational technology that focuses on the use of information and communications technology (ICT) as a mediational tool within collaborative methods (e.g., peer learning and tutoring, reciprocal teaching, project- or problem-based learning, simulations, games) of learning. It is an approach to ICT in education that emphasises an understanding of language, culture and other aspects of the social setting (Scott, Cole & Engel, 1992). Its intellectual heritage can be found in social constructivism (Doise, 1990), the Soviet cultural-historical psychology (e.g., Vygotsky (1978), Leontiev (1978), Davydov (1988)) and situated cognition (Suchman, 1987; Lave, 1988).

CSCL research involves naturalistic observations being used in an exploratory fashion to permit a more complete understanding of this instructional mode. The emphasis is on the process and not so much focused on outcome. Evaluations often result in descriptive studies which focus on artefacts that support or are produced by teams of learners and usually contain participant accounts of their own work. The influence of CSCL research on DoCTA is evident in the type of research questions we ask and in the choice of conceptual framework for organising our evaluations.

Guribye & Wasson (1999) describe the underlying conceptual framework adopted in DoCTA as an integration of three different, although closely interrelated approaches: activity theory (Leontev, 1978, Engeström 1987), distributed cognition (Hutchins, 1995), and situated action (Suchman, 1987, Lave, 1988, Mantovani, 1996). All three approaches underscore the need to look at *real activities* in *real situations* (Nardi, 1996, our italics), and always, in some way, include the context in studies of human activity. One of the goals of this research is to argue that, together, these approaches make up a rich framework for describing, evaluating and analysing collaborative telelearning scenarios.

Salomon (1992) is concerned with effective collaboration and he argues that collaboration will only be effective if there is genuine interdependence between the collaborating students. Genuine interdependence is described as 1) the necessity to *share* information, meanings conceptions and conclusion, 2) the necessity for *division of labour* into complementary roles, and 3) the need for *joint thinking* in explicit terms. In project DoCTA, Salomon's ideas influence the design of the collaborative tasks given to the students – effort is placed in designing tasks which create genuine interdependence between the students.

Coordination theory (Malone & Crowston, 1994) provides a means for specifying (inter)dependencies between, and among, actors, goals, activities, and resources by identifying a *dependency type* (e.g., shared resource) and a *coordination process* (e.g., group decision-making) for managing the dependency. In their work, coordination is defined *as managing dependencies between activities,* hence they have focused on dependence between activities. Wasson & Bourdeau (1997) report that viewing collaborative telelearning from a coordination theory perspective offers a means of understanding the inter-relationships between actors and entities and how these relationships can and should be supported. Adopting Salomon's ideas about genuine interdependence and a coordination science approach, they modelled (inter)dependencies between actors in collaborative telelearning scenarios and they have extended the definition of coordination to be *managing dependencies between activities* (Malone & Crowston, 1994) **and** *supporting (inter)dependencies between actors.* Wasson (1997, 1998) proposes a set of actor (inter)dependencies and related coordination processes for collaborative telelearning. The importance of this work for DoCTA lies in making sure the technological environment within which the students carry out their tasks provides mechanisms that make coordination as effortless as possible. Otherwise coordination issues can become a bottleneck that hinders students from carrying out their individual and collaborative work.

The final area providing inspiration is summarised as follows "...a distributed collaborative learning community is a *'place'* that is created by the individual students through their individual and collective actions, ...The designers' role is to *support the students' work of creating that community*, and in such a way that the computer systems become integrated parts of the students' activity (Fjuk, 1998, p. 70)". Furthermore, Fjuk (1995) concludes that collaborative telelearning applications need to have both a mediating role between the individual learner and the peer-students **and** between the individual learner and her learning tasks. Thus, collaborative telelearning can be understood as a medium for inter-human interactions and articulation of individual work. As designers of DoCTA learning tasks and the technological support environments, we must keep in mind that our role is to provide a supporting environment that makes coordination, communication and collaboration as transparent as possible (Bourdeau & Wasson, 1997) enabling students to create their own learning community. The environment must also support both individual and collaborative work.

3 The Scenarios

The design of collaborative telelearning requires the instructional design of collaborative learning tasks and the specification of the technological design comprising the learning environment configuration including the tools and services available (Wasson & Bourdeau, 1998). Four scenarios PedInfo, IDEELS, DEMETER and VisArt have been studied.

3.1 PedInfo

In the PedInfo scenario, 7 of 18 students in a graduate class *on research issues in pedagogical information science* at the University of Bergen, are geographically dispersed over Norway from Alta and Mo i Rana in the far North, to Holmestrand outside Oslo, to Stord and Haugesund on islands south of Bergen. The class meets physically in Bergen one day every third week. The challenge is to support the students in their creation of a distributed collaborative learning community. Collaborative learning tasks and the technological environment have been carefully designed. The technological environment is comprised of their own email system, a word processor of their choice, and groupware TeamWave Workplace (TW, http://www.teamwave.com). In TW (which uses a room metaphor), 14 tools are provided enabling teams to easily plan, set up a database, design, share documents, link to the web, chat with one another etc. In order to become better acquainted with one and another and to become familiar with TW, a collaborative team building activity was designed (see team building room in figure 1).

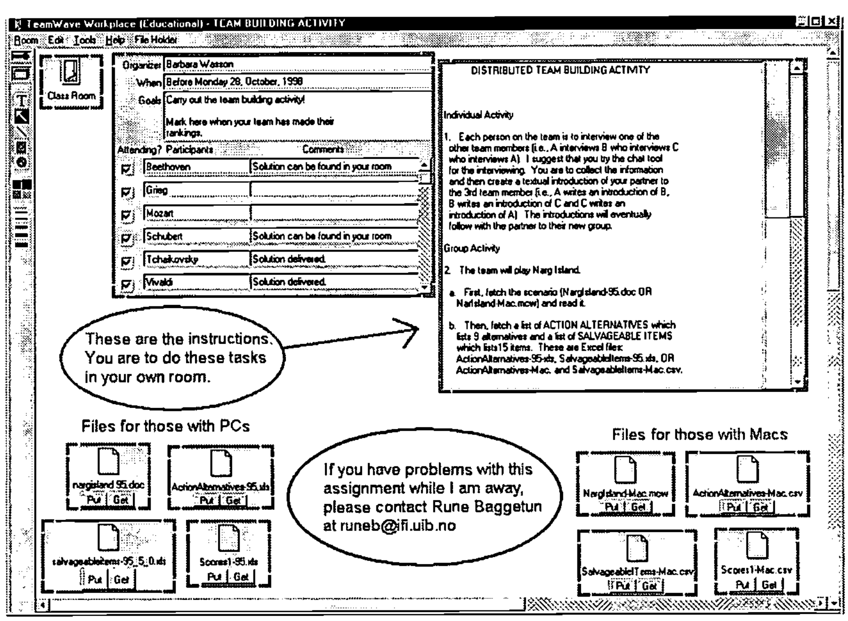

Figure 1 Team building room in TeamWave Workplace

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The team building activity consists of first interviewing one another (virtually) and making a presentation of the interviewee to the others (these were placed in a Participant Profile room), and a group activity (the class was divided into 6 groups) which was a survival game where they had to negotiate a team strategy.

In the top left hand corner you see a doorway tool allows easy movement between rooms – here you see the link to the Class Room. Beside this there is a voting roster tool which has been used to enable teams to indicate when they have completed the activity. Next to this, a file viewer tool holds the directions for the team building activities. In the bottom left and right corners, file holder tools contain files (actually the files sit on the TW server) for the students to download. To access the files the students just press the Get button and the file is saved onto their local machine (to place a file on the server, one just uses the Put button). On the shared whiteboard (the background) text and graphics can be placed, and synchronous communication can be carried out.

TW was chosen for a number of reasons including that it grew out of several research systems developed in the Grouplab Project at the University of Calgary, it is tailorable by the learning environment designer (it is extensible through a easy to use toolkit), and the instructor and students themselves (by creating rooms and though access to a large number of tools), it support both asynchronous and synchronous collaboration, and not the least it is both easy to learn to use and is reasonable priced. TeamWave Workspace will also be used in the IDEELS and VisArt scenarios.

3.2 IDEELS

Project IDEELS (Intercultural Dynamics in European Education though on-line Simulation) brings together a diverse group of educators and researchers from five tertiary institutions in four European countries who share a common interest in simulation and games. IDEELS is an EU Socrates curriculum development project with partners at the University of Bremen, Germany (co-ordinators), the Polytechnic University of Valencia, Spain, the University of Nice, France, and Nord-Trøndelag College and University of Bergen, Norway. The goals of IDEELS include adding impetus to the curriculum development trend towards content & process-based learning and to enhance European competitiveness by providing students with opportunities to learn essential cross-cultural, linguistic and negotiating skills. A generic simulation game is used to complement existing curricula in a wide range of areas including language learning, negotiation, policy studies, political science, environmental issues, cross-culture communication, law, education, and computer science. In IDEELS simulations, students act as high-level negotiators, consultants, and journalists in a fictional world, working to resolve real problems of importance to the European Community – problems that can only be solved through co-operation at the international level.

Teams from the various partner institutions take on different roles in a simulation conducted on two levels: deliberations within a team and negotiations between or among teams. Thus, it can be said that the simulation scenarios are designed to require (inter)dependence among both team members and between teams. Teams are given a common mission where the goal is to produce and ratify a jointly-written document (e.g., come to a consensus and sign either a policy or treaty, or write a set of recommendations). For example, the scenario that is running in the fall of 1998 (http://www.zait.uni-bremen.de/wwwgast/fzhb/ideels/public_html/) requires that the students draw up and agree on a design plan for the educational system for Eutropolis, the New Eutropian Capital. Using Salomon's (1992) definition of genuine interdependence it can be argued that in order to participate in the game there is a necessity to share information, meanings and concepts about the topic of the simulation, a necessity for division of labour within a team in order to build up the teams position before negotiation with the other teams, and a need for joint thinking to come to a consensus so a policy or treaty can be signed by all partners.

The Norwegian participation in project IDEELS (UiB and HiNT) is organised through project DoCTA. The technological environment that has been designed for the participating Norwegian students includes their own word processor, TeamWave Workplace and OPUSi, a computer-based communications system that is accessible through the world wide web and was developed at the Department of Computer Science, University of Bremen. OPUSi enables the students to send written messages within and between teams as well as providing for real-time, online teleconferences. As in the PedInfo scenario, the Norwegian students participating as teams in IDEELS are geographically spread over Norway. It was decided that OPUSi does not provide enough support for these students to collaborate, so TeamWave Workplace has been added to support the collaboration activities.

3.3 Demeter

Demeter (http://hugin.hsh.no/prosjekt/demeter/index.htm) is a European distance education project run by ITE (Organisation for Internationalization of and Innovation in Teacher Education) involving15 European Educational Institutions in Norway (Stord), Sweden, Ireland, Netherlands, Germany, Greece, England, Scotland, Austria, Lithuania, Portugal. Project DoCTA will be evaluating the Norwegian students' (Stord) participation in Demeter. Like project IDEELS, Demeter involves role-playing and provides for cross-cultural education and communication in Europe and includes inter-cultural networks for democracy education, and education in European citizenship within the framework of teacher education. The education is open to students all over Europe to study, compare and produce materials about issues that are of interest for most parts of Europe. Students contribute solutions to local problems in Europe from perspectives true to both their own cultural background, but also as European citizens.

Demeter is based on a parliament metaphor that supports the vision of how a true cross-cultural exchange of ideas, knowledge, understandings and meanings can be arranged. Participation in the parliament requires debate, research, submitting proposals and propositions and voting on the decisions that flow from them. When a consensus cannot be reached, respect for the ideas of others taking part in the democratic process must be shown. Topics discussed in the Demeter Parliament are authentic problems that occur in the real world are considered. For example Children Rights were discussed in the spring of 1998 and in 1999 the topic to be considered will be the preservation of heritage sites. The collaboration tasks are designed around committee work. Students participate as Members of Parliament and join committees where they are to elect a chairperson and secretary, and solve a number of tasks from a problem-oriented and problem-solving perspective. The committee members are to collaborate to write a report to be delivered in a parliamentary session that is working towards a Children's Bill of Rights. At the end of the Parliament session, members of parliament write a farewell speech which summarises the work they have done, the decisions this has brought about, what has been learned, and how the parliament session has influenced their view on the issue that has been discussed. The farewell speech also describes how the work has been conducted including both a description of socialising and the problems encountered while having to cope with parliamentary working methods. Again, it can be argued that this fulfils Salomon's criteria for genuine interdependence.

The technological environment is the Demeter Parliament accessible through the web. The Parliament is a virtual world that includes a Café, a Library, a Post Office, a Lobby where participants can post messages and join discussion groups, and it provides participants with a number of services including an agenda, access to experts, a means of join committees, an area for voting, a means for chatting, a forum for debate and help.

3.4 VisArt

While IDEELS and Demeter dealt with the design of textual based artefact, VisArt has been designed to explore the collaborative design of a visual artefact. The collaborative task will involve intra team collaboration to design a TW room for use in teaching some subject of their choice. Teams will comprise a student from each of the Norwegian partner educational institutions (UiB, HiNT and Stord). This gives a rich mixture of students with various backgrounds. The UiB students are graduate students studying pedagogical information science and thus have a either a background in both pedagogy and information science or just information science. The HiNT students are teachers taking an introductory evening course on information technology and education thus they have little if no backgound in the use of information and communication technologies. The Stord students are third year undergraduate students taking a pedagogical information science course so they are primarily educated as teachers, but have been taking a number of information science courses as well. We feel that this will make an interesting blend and will create (inter)dependencies between the students. We are curious to see how they divide their work and reach a consensus first on what they will design (we expect the students with more pedagogical background to take a lead here) and second how they will carry out the development of the web artefact (we expect the students with more technical backgrounds to take a lead here). The technological environment being designed for these students includes email, TW, their own word processor and the web. Prior to the design task, students are trained in both use of TW and in collaboration.

4 Evaluations

The evaluation aims at a naturalistic study of how participants in collaborative telelearning organise their work and learning activities. In order to collect data about the activities in which the student are engaged, different methods and techniques are being used. The most important sources of information will be derived from observing the students as they collaborate and interviewing them, and also from electronic logging of artefacts used for collaborating (e.g., email, shared whiteboards, chats, to-do-lists) and artefacts designed (e.g., a TW room) during the collaboration. Our theoretical framework influences the evaluation question we have asked and the analyses we can make. Guribye & Wasson (1999) provides a more in depth rationale to the choice of our evaluation approach. For example, three graduate theses focus on using an Activity Theory perspective to examine collaboration patterns in the IDEELS and VisArt scenarios. We are supplementing this overall focus on collaboration patterns and how the participants organise their work, with several graduate theses that will focus on evaluation of the technological environment. For example, one thesis is focusing on the usability of TW by monitoring how students' opinions about the utility of the tools changes from their initial impression to a final judgement after a semester of use. Another thesis is focused on the analysis of TW data logs to look at how the different artefacts were used for collaboration activities. A third thesis is concerned with coordination.

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Multimedia Technologies in Education of Mathematics: An Experiment with Pythagorean Numbers

Sae-Hong Cho & Forouzan Golshani & Youngchoon Park
Department of Computer Science & Engineering
Arizona State University
Tempe, AZ 85287-5406, USA
{shcho, golshani, ycpark}@asu.edu

Abstract: Whereas for most people the only application of multimedia technologies in education is hypertext arrangements of topics plus "page turning," we view multimedia technologies as an effective way of visualizing the abstract concepts that are generally hard to grasp. As such, we attempt to create virtual representations of difficult concepts as teaching/learning aids. The important issue is that the student can then work with the virtual representation by making meaningful changes to the object and seeing the results.

In this paper, we visualize the notion known as the Pythagorean numbers, i.e. the equation $a^2 + b^2 = c^2$, in a way that it can be manipulated by the student. As a part of this, we animate a proof for this equation. In addition, we implement the following variation of the Pythagorean theorem: if the congruent shapes are drawn extended from each side of a right triangle, then the area of the shape which extends from the hypotenuse is equal to the sum of the areas of the shapes which extend from the base and height.

1. Introduction

A number of experiments for improving the quality of education by using the modern technologies are currently underway. Especially, mathematics educators show a great deal of interest in the impact of computers on teaching and learning mathematics. A typical example of new ideas in this area is providing additional visual and/or auditory effects to students. This is commonly achieved by simultaneous use of data in different forms such as text, audio, images, graphics, video, animation, and so on. Generally these representations involve the usage of multimedia tools and techniques. We will explore applications of multimedia technologies used to develop the educational tools for mathematics.

Many students experience difficulties in understanding certain concepts presented by the traditional teaching methods. For such students, a computer can be a useful tool to enhance the students' understanding by providing the visual and/or auditory effects. Most of the currently existing learning and teaching tools are nothing more than mere "page-turning" programs on the computer. That is, these kinds of tools do not make the best use of the strength of the computers as a supplementary method to typical schooling because they are just a copy of the textbook on computer. We will examine these motivations for the project closely.

Another angle of this research is investigation of supporting theories for the development of teaching tools for mathematics. Many existing tools adopted behaviorism as their basic idea. Since this philosophy has been the cause of a number of fundamental problems, we added constructivism and cognitive theory to construct a new background theory as an alternative to behaviorism. The basic concept of the newly synthesized theory is that students can learn the new knowledge by logically connecting it to already existing knowledge. A more detailed discussion of the background theory will be presented in the following sections.

To demonstrate how teaching tools may be developed, we have developed several modules for a variety of concepts in mathematics, physics and chemistry. As an example of selected mathematical concepts, we will present a tool for understanding the Pythagorean theorem which seems very easy at first glance but requires much more work to achieve mastery level. The new educational theory is applied at each step of implementation so that the resulting program will not be a mere explanation of the theorem.

2. Multimedia Technologies and Education

In this section we discuss the steps involved in the development of multimedia tools for educational purposes. While this is not intended to be a complete list, we highlight the major steps.

One of the most important tasks in developing an educational tool is identifying the appropriate topics. Computer technologies may or may not be well suited for all subject areas. In other words, in some cases there are no apparent advantages in using multimedia technologies for certain topics. Therefore, to use multimedia technologies for an educational program, the proper criteria for selecting topics has to be established. Although a detailed discussion of the criteria is beyond the scope of this paper, the following is a sample list: 1) topics that the instructors find hard to explain through the traditional teaching methods, 2) topics that students find hard to understand from the typical schooling method, 3) topics that are explained or learned better if visual/auditory effects are provided, 4) topics concerning 3-D shapes, 5) when computers can provide a simulated environment that the school cannot afford, 6)topics where students need to solve many exercise problems for better understanding, and 7) topics that involve many continuous and chaining steps.

Once an appropriate topic has been selected, an overall environment must be designed. At this stage, the task must be broken down into sub-problems first. Breaking down the task involves both analyzing the content of topics and selecting the proper presentation method for the topic. In the content analysis, the following three questions must be considered: a) What goals can students or users achieve by using the tool? b) How deeply are the topics dealt with in the program? and c) How much related information or knowledge is provided for improving students' understanding?

Choosing the appropriate metaphor and media types for each parameter that is relevant to the topic is another important task in this stage. Among the various media types such as text, pictures, images, sounds, animation, and videos, the most applicable types for the topic have to be selected in order to achieve the maximum effect. Furthermore, the organization of the selected media should be considered so that the users can get information efficiently.

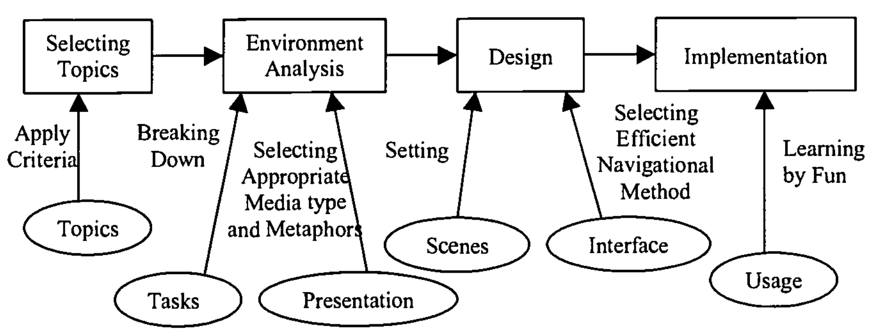

Figure 1. Development Process

The design stage follows task analysis. Setting the appropriate scenes and choosing the method of user interface must be done in this stage. Each scene must be sketched carefully according to the results of the tasks break down. A point to be considered when sketching the scenes is that each scene has to contain a proper amount of data or facts. If there is too much information in the scene, students will be stunned by the amount of information they have to digest and may lose interest. On the other hand, if there is inadequate information, the users will be busy moving from one scene to the other to find the desired information. Another point to be taken into account is the flow of the scenes. The strong coherence between consecutive scenes is necessary, of course unless the theme has changed. The smooth flow of scenes can be achieved by a well-designed user interface. An important requirement is that users must have no difficulty in navigating the program. To offer a better navigational method to users, many techniques have been invented, including task bars, hot words, dialogue boxes, and using animated icons and histories.

The final stage in developing an educational tool is the actual implementation and coding. All the plans chosen during the previous stages have to be synthesized, organized and displayed in such a way that gives the maximum effects to the users. The ultimate goal here must be that the users will enjoy what they are. By simply using a computer mouse to point and click on a particular picture, word, or button, stories and information come alive on a computer screen. The phrase "edutainment" is the buzzword for this. The explained processes are summarized as presented in [Fig. 1].

3. Synthesizing Constructivism, Cognitive Theory and Behaviorism

In developing an educational tool, a consistent educational theory is needed so that we would not digress from the initial set of goals during the entire development process. A combination of cognitive theory, behaviorism and constructivism will provide the ideal setting for the development of educational tools. The synergized theory emphasizes both accumulating personal experiences before attempting to learn a new subject and by providing enough exercise problems to enhance student's ability to apply the concept after learning it. The following characteristics from the current educational theories are identified and will be resolved into the new educational framework: 1) From cognitive theory - Habitual process of perceiving and thinking, Thought that forms association, Seek interconnection between connected ideas and individual analogies, and Awaken knowledge in long-term memory, 2) From behaviorism - Learn by doing, experiencing, and engaging in trial and error, Give repetitive stimulus and get response, Present similar stimulus material, and Give some reinforcement immediately after the response, 3) From constructivism - Constructing knowledge rather than mere memorization, Provide complex learning environment, Collaborate or cooperative learning, Examine the same material from multiple metaphor, and Invoke student's reflexivity

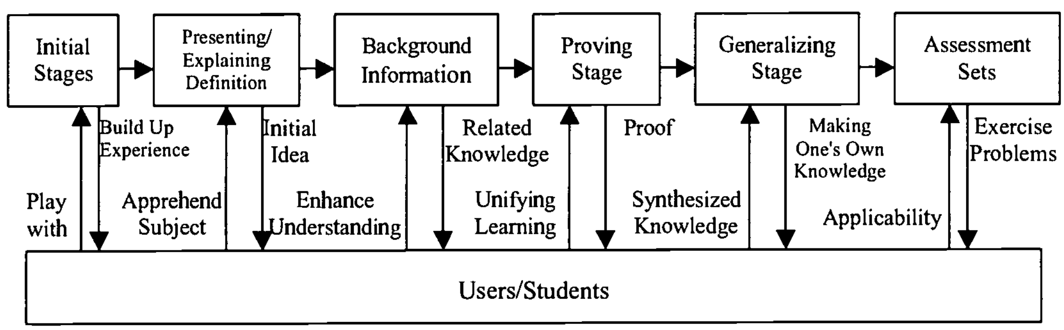

Figure 2. Steps for Developing Educational Tools for Mathematics

The tools provide the following features, which would help the students, learn mathematics step-by-step.

- Building the preliminary stage(s) at first so that the users remove the unfamiliarity from the new topic and make an experience by playing with that topic without deep touch
- Presenting/explaining the definition in order to give the students the initial idea what they are going to learn
- Giving the related background, information, and/or knowledge to enhance the students' understanding
- Doing the proof, if necessary, for the students to consolidate what they are learned systematically
- Generalizing and/or synthesizing the topic, and discussing the variations to raise the students' interest and to encourage their curiosity in the given topic
- Providing enough assessment sets for the students to know how the subject they are learning is applied to various situations

We feel that in such a framework, the designer would work closely with the educators and students in the design and implementation of the learning tool. [Fig. 2] illustrates the steps to be followed.

4. An Example: Pythagorean Numbers

At Arizona State University Multimedia Systems Laboratory, we have developed a large number of modules, each targeted to demonstrate how various technologies may be effectively utilized for delivery of learning material in the fields of mathematics, chemistry and physics. We present in detail one of the modules, namely the Pythagorean Theorem. Although this demonstration program is targeted high school students, it clearly shows that the techniques are applicable to all levels of sophistication.

4.1. Selection of Topic

The selected topic, the Pythagorean theorem, is one of the most popular theorems in trigonometry. Most students consider this theorem to be easy and memorize only one equation, $C^2 = A^2 + B^2$. However, there is much more that cannot be compacted into just one equation. In fact, this theorem represents the special case of the law of cosines which establishes the general relationship among the sides and angles of a triangle. Therefore, to understand the Pythagorean theorem, students must understand the law of cosines and possess the basic knowledge about the concepts of angles and sides of a triangle, and the triangle itself. Moreover, the proof for the theorem is not easy even to the medium level of students.

4.2. The Preliminary Stage

At this stage, the users can get the first experience of the relationships between angles and sides of a triangle simply playing with any vertices in the given figure. A brief description is given in the left upper window so that the user will know what to do at each stage. When the users move the vertex from one place to the other place on the right side of window, they can see the corresponding changes of sides, angles, and the areas of three squares that are made by each side of a triangle. They also see the changes of equations which are shown on the left lower window. Since the Pythagorean theorem comes into existence when the given triangle is a right triangle, the sound effect is added so that the users know when they have created a right triangle. The users can get a rough idea of what they are going to learn by just playing.

4.3. Presentation of the Concept and Definitions

The users are probably ready to learn the new topic after getting the first experience of the previous stage. Therefore, the formal definitions of the Pythagorean theorem and its general form "Law of Cosines" are presented and explained at this stage [Fig. 3]. The figures and their written explanation will help the users' understanding of both concepts.

4.4. Providing Background Information

The user may or may not have enough knowledge to understand the new topic. For such students, presenting the basic knowledge is a necessary step in the new teaching and learning tools for mathematics. Of course, the students who know the basic knowledge well can skip this stage and go on to the next stage directly without wasting their time. For the Pythagorean theorem, the users must know the angles and sides of the triangle and the triangle itself. Therefore, the explanation of angles and triangles are given at this stage.

At first, the users can see the general definition of an angle, the unit of measurement for an angle, and the various types of angles on the left window [Fig. 4]. After getting some basic concepts about angles, the users can pick any angle name to get the details of that particular angle. The red color is used for the text of angle names. The red colored text indicates hotwords which evoke the other events when pressed. The users can see the definition of the specific angle and its figure by pressing the angle name. On the figure, the users can play with the vertices, and see the changes in angle. The change in angle is calculated and shown on the right lower window. If the angle is out of range to the given angle type, both a written message and the sound alarm are produced.

The section for the triangle is composed similarly [Fig. 5]. The definition of the triangle and its sides are given as well as the various types of triangles. Like the angle section, the triangle names are formed as hotwords. By pressing them, the users can see the definition of the particular triangle and play with its vertices to see the changes of angles and sides. The measurements of three angles are shown, and both the written message and the sound alarm are produced when any one angle has not satisfied the condition for the particular triangle type.

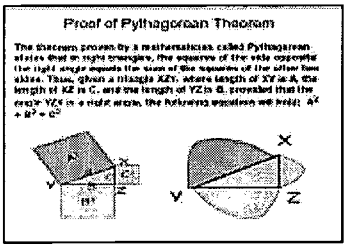

Figure 3. Presenting Definition

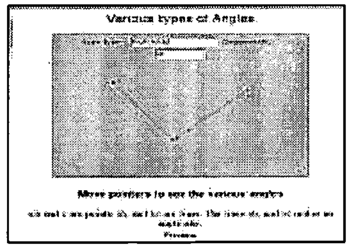

Figure 4. Background info.: Angles

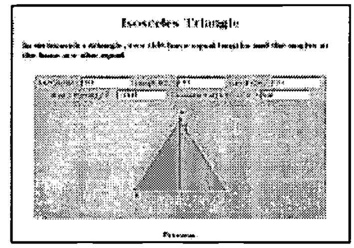

Figure 5. Background info.: Triangles

4.5. Proving Stage

Many mathematical concepts require a proof. Most students find it hard to prove a mathematical theorem because a complete understanding is needed in advance. If the visual and auditory effects can be given to each step as well as a written explanation, the users will easily understand the processes of proving theorem. For the Pythagorean theorem, the proof can be easily understood if the animation technique is used. [Fig. 6] shows the selected phases of thirteen steps for proving the theorem [Golshani, Park, Cho, and Friesen, 1997]. The users can see each phase of the proof in the right window. Its corresponding explanation is also given in written form. If the users cannot understand a certain phase, they can go back and forth until they understand thoroughly. One thing that needs attention in the figures is that the same-colored areas between the adjacent phases have the same area. Of course, the reason why they are the same is well explained within the text.

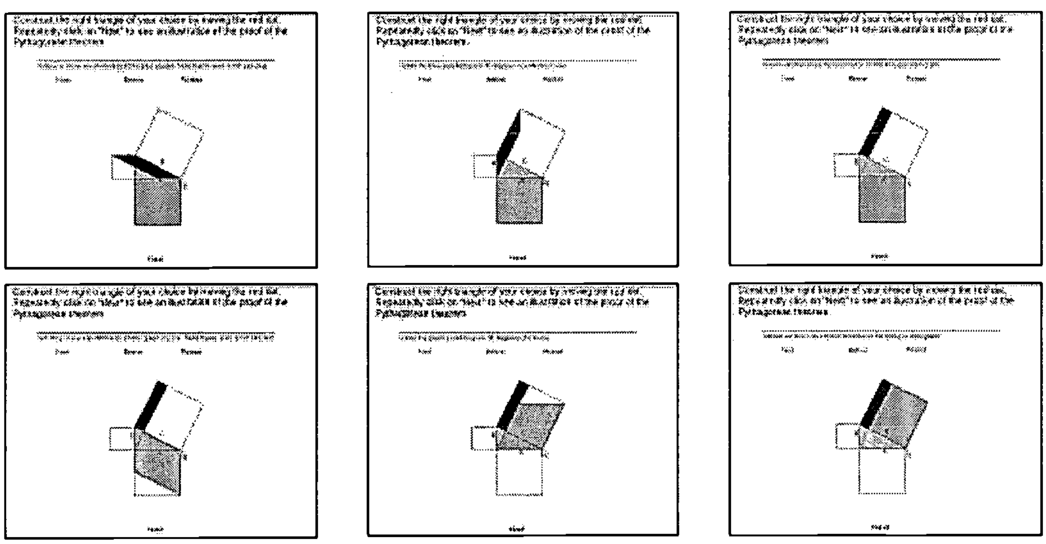

Figure 6. Animation of proof: Selected Examples of 13 Phases

4.6. Generalizations

By now, the user should be able to understand the topic completely by synthesizing all the things they have learned from the previous stages. The users can construct one solid idea about the topic. As illustrated in [Fig. 7], the student can synthesize the Pythagorean theorem by playing with any vertices. According to the movement of vertices, the areas of three squares are also changed. However, the sum of two small areas always equals the area of one big square, which satisfies the Pythagorean theorem.

In addition, we present the following extension of the Pythagorean theorem. As presented in [Fig. 8], if the user draws an arbitrary shape from any side of the given triangle, the congruent shapes are automatically drawn from the other two sides of the triangle. A simple animation shows that the area of the shape, which extends from the hypotenuse is equal to the sum of the areas of the shapes which extend from the base and height.

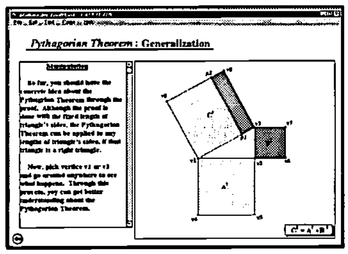

Figure 7. Synthesizing Stage

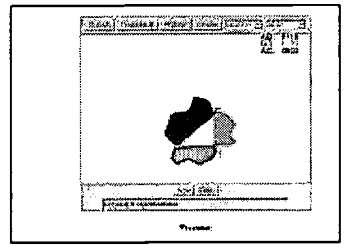

Figure 8. Variation of Pythagorean Theorem

4.7. Assessment Stage

The new teaching and learning tools for mathematics must provide a set of questions by which the student can assess his understanding of the topic. If the users understand the fundamentals of the topic, they can solve any questions and use the already acquired knowledge in practice. The exercise problems are a means to confirm how well the users understand the given topic. The users can improve their abilities through problems, which they appear with various types in the real world.

5. Conclusion

On the whole, the currently available educational tools for mathematics that are made by using computer technology are not good when used as a supplement to the traditional class. This is because there is no enough correlation between the computer scientists and the mathematics educators. This highlights the difficulty in creating of effective educational applications. This research is an attempt to engraft the computer scientist's technical background to the field of education in order to produce effective educational applications. First of all, the computer multimedia technology is fully utilized to develop new tools for teaching and learning mathematics. In addition to, the whole process of development follows the new theory that is formed by combining constructivism, cognitive theory and behaviorism. The actual implementation is performed to demonstrate how the new tools should be developed under this theory.

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A Hybrid Semantic/Connectionist Approach to Adaptivity in Educational Hypermedia Systems

D. J. Mullier
D. J. Hobbs
D. J. Moore
Faculty of Information and Engineering Systems
Leeds Metropolitan University
England
[d.mullier][d.hobbs][d.moore]@lmu.ac.uk

Abstract: Described within this paper is an adaptive hypermedia system (AHS) that utilises symbolic AI and connectionist AI to provide generic student modelling. The needs for generic tutoring systems are discussed, in terms of a system that is applicable to a multitude of teaching domains, whilst maintaining diagnostic facilities of the student. The hypermedia architecture is based on a semantic-network allowing the use of automatic reasoning to produce weighted links. A type of student model is employed to record information about the student so that the weighted links can be tailored for the student's interests. A neural network is used to grade the student into an ability level based upon their interactions with tutorials. A further neural network is used to recognise the movements students make as they browse the hypermedia and link it to tasks and abilities. This offers the potential to extract information about the student without direct dialogues.

Introduction

In the face of growing economic pressures, Leeds Metropolitan University is seeking increasingly to use educational technology and computer based learning to solve the practical problems of providing for increasing student numbers given static or decreasing resources (Willis 1994), a widespread problem shared with many other educational institutions (Sillcorn 1996). A particular interest concerns the educational use of hypermedia. This is seen as being potentially educationally valuable in that there is evidence to suggest that learning is improved when a student is allowed to follow pathways of their own choice, at their own pace and able to monitor their progress by instant feedback questions (Kibby, Mayes 1990).

A major concern, however, with the educational use of hypermedia is that of user navigation. The issue is how, on the one hand, to prevent the user from becoming overwhelmed with information and losing track of where they are going, whilst on the other hand permitting them to make the most of the facilities the hypermedia offers. One approach to remedy this is to restrict the number of links made available to the student. The concern that this might lead to an impoverished set of learning opportunities can be countered by the use of adaptive hypermedia, seeking dynamically to configure the available links as the user proceeds.

The educational importance of adaptivity

Our argument for the importance of adaptivity in an education hypermedia environment is based in part on the claim of Elsom-Cook (1989) that the perfect tutoring system should be able to slide between the two extremes of total constraint and total absence of constraint, according to the student's needs and current state of knowledge. In a similar vein, Hartley (1993), cf (Ford 1995) argues that when there is a mismatch between the strategy of the learning system and learning style of the student, performance is degraded, suggesting a need for support for different styles and viewpoints of users. With this in mind, one of our aims is to facilitate hypermedia systems with the ability to adapt to their students' needs as they progress through the systems (Mullier 1996). To this end we have developed a prototype hypermedia shell, which provides a combination of knowledge-based representations (which we refer to as "semantic hypermedia") and neural network models ("connectionist modelling").

We argue that this approach overcomes two major concerns in the domain of educational hypermedia. One is that since a hypermedia learning systems shift the responsibility for accessing and sequencing information from the teacher to the student, this may entail a cognitive overload: "The number of learning options available to learners places increased cognitive demands upon the learners that they are often unable to fulfil" (Jonassen, Grabinger 1990). A particularly important manifestation of this cognitive overload occurs when a user becomes "lost in hyperspace", not finding or being presented with the required information, a problem caused by the complexity associated with "having to know where you are in the network and how to get to some other place that you know (or think) exists in the network" (Conklin 1987). Our prototype seeks to deal with this problem essentially by making more links available to students as their knowledge of the domain is judged to be improving; in an attempt to provide the sliding scale approach advocated by Elsom-Cook, the novice user of our system is freed from much of the complexity associated with an unfamiliar system teaching an unfamiliar subject, while the more advanced student is freed from unhelpful constraints.

Dynamic linking

In order to enable to enable provision of a suitable regime of dynamic links to the student, our prototype adds to the standard hypermedia paradigm (i) a student model, (ii) a semantic network to describe the domain and (iii) a control system, the "hypermedia manager", for regulating the links offered to a given user, in the light of information from the previous two modules. The student model comprises a connectionist device for characterising a student's browsing strategies and a device for grading the student according to their ability to answer questions and complete tutorials. The semantic network (Beynon-Davies et al 1994) is a formal method of describing the domain. Its use imbues the system with the ability to perform reasoning processes drawn from the field of artificial intelligence, which in turn allows the system automatically to generate links and ascertain the student's interests. These elements are referred to collectively as "semantic hypermedia" and are described further in the following section. Finally, the hypermedia manager utilises information from the student model and the semantic hypermedia and determines which links are offered to the student, according to the student's current profile and the domain semantics.

This architecture allows three levels of dynamic linking, resulting in a highly adaptive system from the user perspective. One level of dynamic linking is provided by the semantic hypermedia element of the system. This is based on a semantic network using typed links such as is-a, has-part and kind-of (Beynon-Davies et al 1994). Production of this network is the responsibility of the domain author, but the system is able to use it to produce links between nodes in the hypermedia system automatically. It achieves this by building direct connections between nodes which are already connected indirectly via the semantic structure, and by weighting them according to the strength of the semantic relationship, construed as the number of semantic links indirectly connecting the two nodes. Weighting the links enables the system to suppress low weight links and/or dynamically tailor the displayed links to a given student in order to reduce complexity for novice students. This first level of linking is the most processor intensive, since the whole domain must be processed. However, these links are generated before a student encounters the system.

The second and third level, tailor the links to an individual and are achieved whilst the system is in use. The second level of dynamic linking requires a system to record information about the student. The student model provides information about the student's ability and their interests in terms of previous node types visited (these are stored in the Student Experience Record). The hypermedia manager uses this to modify the already present weights stored with each link. Thus the links are dynamically modified for a particular student at a particular instant in time. A third method of dynamic linking allows a human teacher to modify the link weights so as to favour certain areas of the semantic hypermedia. For example, the teacher may want the student specifically to look at a certain area of the domain. This would be accomplished by assigning a priority to certain class nodes in the semantic network. The system then increases the weight for each instance of this class, thus making it more likely to be selected.

Semantic hypermedia

The central feature here is the use of a semantic network, from which the hypermedia model that forms the basis of the student's interaction is generated. The use of a semantic network has certain advantages from the author's point of view. First, "they are natural to use, since related concepts tend to cluster together in the network...[and] ... an incompletely or inconsistently defined concept is easy to spot since a meaningful context is provided by those neighbouring concepts to which it is already linked" (Conklin 1987), cf (Beynon-Davies 1994)). Further, the use of the semantic network forces the domain author to think about how to structure each additional part of the domain and allows each subsequent part to be typed and attached to the semantic network. Again, use of a semantic network may help solve the problem of "linkitis" (Conklin 1987), whereby an author, not knowing how to link a node to an existing hypermedia network, errs on the side of caution and links nodes to other nodes that may not be relevant; this, coupled with the fact that most hypermedia systems have no facility for qualifying one particular link as more or less relevant than another, can add to the cognitive burden of the learner.

Importantly, these advantages for the domain authors translate into advantages for the users of the system. Structure in general is widely seen as important in educational hypermedia systems: "the belief that hypertext can mimic human associative networks implies that an appropriate method for structuring hypertext is to mirror the semantic network of an experienced or knowledgeable performer or expert" (Jonassen, Wang 1993). Yet more importantly from the point of view of the current project, it is the use of a semantic network that forms the basis for the automatic generation of hypertext links, by utilising automatic reasoning algorithms.

A semantic network is therefore created for a domain and substantive "content nodes" are attached to it; these content nodes are intended to provide information of potential educational value to the student and may include calls to different media drivers, eg to play a sequence of video. It is not necessary to link content nodes to other content nodes, since they are already connected indirectly through the semantic network. Additionally these indirect links provide information about the strength of the relationship between any two nodes in the resulting hypermedia system. It also provides information about how the nodes are related, in terms of the link and class types connecting them together.

Using a Solar System domain as an example, the nodes "Mars" and "Earth" can be linked by an is-a link to the class node Planet. This gives a simple knowledge base, namely the knowledge that both Mars and Earth are planets. The system can now automatically link Mars to Earth. Further direct links might be made from Phobos to Mars and from The Moon to Earth, and this would allow the system to link Phobos to The Moon, again providing a useful link without any intervention from the author. Further, links can be given a weight according to the length of the path that indirectly connects them.

Student model

The student model is made up of four sub-components:

- Browsing Pattern Recogniser (BPR)
- The Fuzzy Rule Base (FRB)
- Tutorial Supervisor (TS)
- Student Experience Record (SER)

These sub-components are described below.

The use of neural networks within the student model

Both the TS and BPR are neural network devices. We argue that the use of neural networks offers a potentially attractive way of surmounting the difficulty of recognising unclear or complex patterns (complex patterns made by a student using the hypermedia and a potentially dynamic grading of questions and students). We argue this partly on the negative grounds that the alternative, namely writing production rules to recognise these strategies, is likely to be "difficult, incomplete and non-versatile" (Mullier 1996, Tsutsui 1991). There are interesting precedents in the use of neural networks for student modelling (e.g. (Bergeron et al 1989, Tsutsui 1991, Battitti, Serra 1991), and in the current case building the neural networks could be expected to be quicker than building the equivalent symbolic AI components. Further, the resulting networks are likely to be very fast in execution and therefore ideal for real time applications (Chiu et al 1991). Other useful network properties are their pattern recognition ability on imprecise data and their potential ability to adapt to situations where a student has achieved a result by unconventional means. We maintain a compelling prima facie case for investigating their use within the student modelling provisions of our hypermedia shell.

The Tutorial Supervisor (TS)

The TS measures the ability of the student by examining the student's interactions with tutorial nodes. Such nodes may present the student with a simple question and answer session or may give the student a goal to achieve, requiring the student to browse the hypermedia and return to the tutorial node to complete the task. The results obtained from the student's interaction with a tutorial node are utilised by the TS to update its current level for the student. Clearly, it is fundamental to this that tutorial nodes are provided in the hypermedia system. Such nodes however are seen as valuable in their own right, in that simply browsing through a hypermedia system on the part of a learner may not be enough to produce any appreciable transferral of structural knowledge, and it is likely therefore to be necessary to provide exercises that explicitly test the learner's knowledge of the domain (Jonassen, Wang 1993). Tutorial nodes are essentially empty boxes into which a particular tutor can place suitable opportunities for learner interaction; they are likely therefore to be places within the hypermedia where the student is questioned about information stored in nodes elsewhere in the domain. They may make convenient points of entry into the domain, as a student is given a goal by the tutorial node, and be useful intermediate reflection and debriefing points.

The TS operates on the basis of student interactions with these tutorial nodes. It takes the student's current level (for new students this will be the lowest level), the question/tutorial's current difficulty level and the result of the interaction between the question/tutorial and the student. It outputs an updated student ability level. We argue that a specialist type of neural network (Kohonen self-organising map) is a useful means of accomplishing this, since it can adapt to different domains without the need for external intervention (unsupervised learning). Our experiments with such networks have provided results which clearly demonstrate that the network is able to adapt to different domains, where similar student levels provide different results (an expert score for one domain may be in the range of 90-100% say, whereas in another domain it may be 70-100). This on-line adaptability is only available with unsupervised neural networks.

In addition to judging the ability of students, the TS is also able to adjust the difficulty rating of questions. This is seen as valuable on the basis of the pedagogical principle that it is useful to present to a student questions at or just beyond their current ability (Bergeron et al 1989). Whilst the domain author is expected to provide an initial grading of questions and tutorials, this grading may turn out not to be appropriate in practice. The system is therefore able to examine the interactions between the population of students and the questions. If, say, the domain author grades a question as difficult, but results with students show that students of novice ability score highly with the question, then the question appears to have been graded as being harder than it actually is. If this situation occurs then the benefits of providing a student with questions at or just beyond their ability level is lost. The student may become frustrated by answering questions that are below their ability and is therefore less likely to improve their ability level (Bergeron 1989). It is therefore important to maintain an accurate level for each question and tutorial. The re-grading of questions is a gradual process, since it is unwise to alter a question's grading with respect to an interaction with just one student. The TS is able to re-grade questions dynamically and continually without making extreme judgements based upon one observation.

The Browsing Pattern Recogniser and Fuzzy Rule Base

The BPR is designed to identify movement patterns and strategies employed by the student as they move through a hypermedia domain. A number of specific hypermedia browsing strategies have been identified by empirical studies of users of hypermedia systems (McAleese 1993). Examples are pathiness, ringiness, loopiness and spikiness. Such patterns have been identified as offering the potential of providing "psychologically important information about the user" (Canter et al 1985). Recognition of the strategy being adopted by a given user during a given interaction is potentially useful to both the system and to a human tutor, but tends to be very complex (Canter et al 1985), not least because a user may adopt more than one strategy for a particular session, and may appear to be utilising different strategies at different times (Mullier 1996). The BPR seeks to provide such recognition and, because of the task's inherent complexity, adopts a neural network approach.

Once browsing patterns have been identified then the system attempts to utilise the information to determine what it is the student is doing. Such information linking browsing patterns to particular tasks does not currently exist. Therefore the system provides a unit that is capable of extracting this information as the hypermedia is used. The information linking browsing patterns to tasks and particular abilities of students is provided by the tutorial nodes and the TS respectively. Tutorial Nodes induce the student to perform a particular task as defined by the author. The student then completes the task using a browsing pattern, the system then records this information. Mapping tasks and abilities to browsing patterns in a direct manner is not suitable, since different browsing patterns may be used for similar tasks and vice versa. Instead it is necessary to pick out overall trends (generally high ability users use browsing pattern x to locate a specific piece of information, for example) over a period of prolonged exposure with many students. This is achieved by the utilisation of fuzzy logic. A Fuzzy Rule Base (FRB) is able to adapt to a complex and changing environment as the system is in use, in a similar fashion to a neural network. The important difference, however, is that the rules inside can be read and interpreted by a human. Therefore the hypermedia system shell (called Hypernet) is a hypermedia research aid, potentially capable of providing the important information describe by Canter et al (1985).

Several networks have been trained and tested on data generated from programs written to produce a rich set of simulated student browsing patterns. Results of tests of the networks have again been encouraging. For the BPR a back-propagation multi layer feed forward network has proved to be an effective network type, showing high levels of accuracy in pattern recognition. A Kohonen network, however, has also proved able to recognise browsing patterns and in addition offers the promise of detecting previously unidentified patterns.

The Student Experience Record (SER)

The SER uses an overlay model to build from a history of nodes in the semantic network visited by the student. This can be seen as a characterisation of the student's interests. This is stored for eventual use by the dynamic linking system, which seeks to tailor links more closely to the student's interests as they use the system. The overlay model records information about particular nodes in the domain. Information such as visited/unvisited indicates a student's interests. Information regarding how much a student knows about a particular concept can also be inferred from results with tutorial nodes. The SER is not covered in detail here since it draws heavily from related work (Brusilovsky 1996).

Conclusions and further work

This paper has described a novel approach to adaptive educational hypermedia. By allowing for a sliding scale of constraint, from complete constraint to total freedom, upon a student's exploration of hypermedia material (in terms of the number of links offered). The approach currently being prototyped represents a promising means of alleviating navigation difficulties whilst allowing the student to take advantage of the hypermedia material, without swamping them with too much information. The system currently exists as a proof of concept prototype in that it operates highly successfully with simulated student data, thus validating the pedagogy in this technical sense. An immediate task involves field tests of the system. A large number of students using it for an extended period is required. An important aspect is the use of the system in a range of domains, since the system is designed specifically to be applicable to a multitude of domains and its modular design facilitates the incorporation of different semantic networks.

In summary, then, the approach to adaptive educational hypermedia adopted by our prototype promises, we believe, major educational advantages. A range of interesting and important issues remain to be addressed, however. The continual need to provide for increasing numbers of students with a wide range of abilities makes continued investigation of such issues imperative.

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Maintaining Information Awareness with Irwin

D. Scott McCrickard
College of Computing and GVU Center
Georgia Institute of Technology
Atlanta, GA 30332-0280
mccricks@cc.gatech.edu

Abstract: The ongoing explosion of Internet usage has many positive effects for the educational community, but it makes it difficult to stay updated on the status of information that is important. To address this need, we created Irwin, a set of configurable information monitoring tools that endeavor to maintain a desired level of awareness for different types of information with minimal interruption to other important tasks. This paper describes Irwin and examines how four users used it over a five-month period.

Introduction

The ongoing explosion of Internet usage has many positive effects for the educational community. Email can connect colleagues separated by thousands of miles. Usenet news can allow professors and students to communicate outside of the classroom. The World Wide Web provides both essential information and much needed distractions. But with these positive effects come new problems.

Although this information is readily available, it is updated at irregular intervals, making it difficult to keep track of changes. For example, a professor may want to monitor a class newsgroup on the days leading up to an assignment due date, or a researcher may want to be updated on the score and status of a ball game on the evening before a paper due date. Another problem is that information can take a significant time to download and display. Consider the time required to download a weather report from the Web, complete with colorful icons and advertisements, at a time when a student is late for a class across campus.

People in academics often want or need to be aware of changes in the types of information in these examples, but they cannot (or should not) spend all of their time reading mail, scanning newsgroups, and surfing the Web. One solution is to use visualization and communication tools to help maintain a desired level of awareness. These tools should include an omnipresent display to allow the user to check on the status of resources with little or no effort, yet the tools must use limited screen space as the user will often want to use other applications that require significant screen space. We try to achieve a balance between these competing requirements with our Irwin information awareness system.

Irwin (Information Resource Watching In a Nutshell) is a set of tools that uses graphical, auditory, and textual communication mechanisms to help the user maintain a desired level of information awareness. This paper outlines ways in which Irwin can assist students and faculty in maintaining awareness, and it describes a field study that examines how four academicians used Irwin to maintain information awareness over a five-month period.

Irwin

Irwin (McCrickard & Rowan 1996) monitors Internet information resources and alerts the user of updates and modifications. Irwin consists of a set of *hypertools*, small reusable programs that can run simultaneously and share information. The central tool in Irwin handles the visualization and user interactions, while the remaining tools process the information from each resource and update the visualization tool when important changes occur.

The information resources monitored by Irwin can include email folders, Usenet newsgroups, Web pages, and weather data. The email and newsgroup hypertools monitor the messages in a folder or group, alerting the user when new messages arrive. The Web tool summarizes headers, lists, and hypertext links on a Web page, allowing the user to monitor news wires and hotlists. The weather tool monitors the weather conditions and forecast for a given city.

When users initially start Irwin, it tries to determine their informational interests by examining their email files and Web bookmarks. (Since users are not required to answer a list of questions at startup, they are often more likely to use Irwin.) The user can then configure both the information monitored and the way in which it is displayed after getting used to the power and flexibility of Irwin.

To show both an overview and details simultaneously, Irwin uses a *confluent zoom* display. A confluent zoom provides multiple views of a resource simultaneously with each view having a different level of granularity. With a confluent zoom, the user can see overview and details with minimal effort, and the context of the detailed views is maintained at all times by the coarser views. Since intermediate views have proven useful in graphical tools such as map browsers and medical imagery (Plaisant, Carr, & Hasegawa 1992, Plaisant, Carr, & Shneiderman 1995), we expect that the intermediate views will smooth the transition from the high-level overview to the detailed zoom view.

IMAGE NOT AVAILABLE

The image displayed here is a screenshot of Irwin. In its confluent zoom, Irwin employs an auditory cue, an icons view, a navigation bar, and several textual views. In the icons view (the leftmost view in the above image), the state of each resource is reflected by an icon. When the resource changes, the appearance of the icon changes and an auditory cue is played. If user selects an icon, the other views are updated to show information about the corresponding resource. A navigation bar (second from the left) shows a syntactic encoding of the resource contents and can be used to select the messages displayed in the textual views (the two rightmost views). Users can configure the orientation and placement of the icons with respect to the other views and can even choose to hide the other views until some event happens, e.g. an icon is clicked.

Auditory cues

Auditory cues provide a means to attract users to a change that has occurred. They may be the only way the user knows about the change if the display is obscured or not in the user's current line of sight.

We selected sounds that are distinctive but are not distracting and, most importantly, are short. Each is less than two seconds in duration, which we expect will be long enough to be noticed but not too long to become an annoyance. In our initial configuration, we tried to select sounds that were indicative of the resource; for example, a dog bark for mail (dogs always bark at the mail carrier) and a splat for news (similar to a newspaper hitting a front porch). Of course, the user can select from a list of sounds (we provide twenty) or create and use their own sounds.

Icons

Icons are used in interfaces because they provide a universal representation in a small amount of space. In a WIMP environment they can both provide information and invite the user to click to obtain more information.

IMAGE NOT AVAILABLE

The image displayed here shows several of the icons used by Irwin. Each icon is a 16-by-16-pixel bitmap that reflects the status of information resources and provides a gateway to more detailed views. The color of the icons change to reflect the recency of updates to the resource: the resource's icon is originally black, but when a resource is updated its icon changes to red. Over time, if the resource is not updated its icon color fades. It never fades entirely to black until the user clicks on it.

In addition, the bitmap itself changes based on the state of the resource. The weather icon changes its appearance to a sun, a cloud, or rain to reflect the current weather conditions, and the spider icon changes to a dead spider when its Web site is not accessible. These icons show (top to bottom) the mail, sun, rain, live Web, and dead Web bitmaps.

Navigation bar

Irwin needs a method for visualizing and navigating a list of items, such as an email address list or a list of news headers from a Web page. While a scrollbar is a widely used navigation tool, it shows little information about the content of the list. Irwin's navigation bar leverages the familiar scrollbar metaphor by providing the same basic look and functionality as a scrollbar (arrows, a trough, a thumb), but the trough space of a navigation bar is used not only for navigating the list but also for providing an overview of the contents of the list. Each item in the list is represented by a line in the trough. The thumb (the black box surrounding several graphical lines) indicates the elements that are shown in the textual listbox. To encode information about the list, we used two classes of encodings: syntactic and semantic.

A *syntactic encoding* is based only on the structure of the word being encoded. Advantages of syntactic encodings are that they require no user input and they are consistent between sessions and between users. In Irwin's syntactic encoding, a word or phrase is represented with a series of blocks of pixels, where each pixel block represents a character in the word. To differentiate between words, Irwin colors the blocks that correspond to vowels such that `a' is red, `e' is orange, `i' is yellow, `o' is green, and `u' is blue.

IMAGE NOT AVAILABLE

For example, the image displayed here shows a portion of a navigation bar representing several news postings by Annie Anton. Her login (anton) is represented by a red block, two black blocks, a green block, and a black block.

We expect the syntactic encoding to be most useful for mailing lists and newsgroups where a small number of people are responsible for a large amount of the activity. In the previous example, Annie Anton regularly posts computer jobs and internships to a local news group - by using Irwin, her postings can be identified with a glance. Also, the syntactic encoding works well for course newsgroups where the students post questions and concerns and the professor posts responses and clarifications. Since the encoding for the professor would appear quite frequently, it should be easy to recognize.

A *semantic encoding* uses information about the meaning of each list item to create the encoding. In Irwin, clusters of related items are created, and the pixel blocks for items in a cluster are identically colored. The clusters can be created automatically using the Lance-Williams dissimilarity update formula (Frakes & Baeza-Yates 1992), or the user can specify the clusters using keyword matching. The Irwin screenshot earlier in this paper showed a navigation bar using semantic encoding, where email messages are colored based on the sender group (faculty, staff, students, other).

We expect the semantic encoding will be most useful for resources with large amounts of information on a number of different topics. For example, news articles taken from a Web page can be clustered based on the topics of the articles, with the most frequently occurring topics being colored. Initially, the topics can be created automatically, then later the user may want to specify topics of interest.

We also encode the time at which the message was stamped by indenting the message according to the hour; for example, messages received at 3 PM will be indented three blocks. This is intended to group messages by arrival time, thus facilitating searches and browsing. If users know the time at which a message arrived, they can identify the range of messages in which it must fall using the navigation bar.

Textual views

Graphics alone might not show all the information necessary to understand a message - at some point a textual view will likely help. Irwin incorporates two textual views: a header list and a message view. Irwin constructs lists of headers for each resource, the senders for email and Usenet news, abbreviated headers for Web pages, and days of the week for the weather forecast. If the user selects an item from the list, the message view shows a more informative summary of the original message.

While the Irwin textual views can give the user an up-to-date peek at the contents of the monitored resource, it is not meant to replace the programs that are designed for reading, browsing, and searching the resources. To assist the user in bridging the gap between awareness and other tasks, Irwin allows the user to jump to various readers and browsers to view the resources of interest. Irwin is automatically configured to jump to a Web page using Netscape Navigator if a URL is referenced, or Irwin can be configured by the user to start or activate various email readers, news readers, Web browsers, or other programs and commands.

User reaction

While studies like our navigation bar experiment are helpful in analyzing performance for certain specific searching and identification tasks, the true test of tools, particularly for a difficult to quantify task like awareness, is the reaction of the public. By offering Irwin to users and observing how they use it, we hope to answer some of these questions.

Nine faculty members and graduate students attended a presentation and demonstration explaining how to set up and use Irwin. Seven people tried Irwin at least once, and four of those continued to use it regularly. The remainder of this section summarizes their comments. (A full report of their comments is available as well (McCrickard 1997).)

We asked those who did not use Irwin why they chose not to. Most simply did not feel like they needed such a tool. One person noted that she didn't receive much email and only rarely browsed the Web - she simply had no use for tools like Irwin. One user wanted a less passive visualization tool. He reported the he felt he did not have enough control over when the resources were checked. He seemed more interested in a typical browsing or reading tool.

All of the frequent users configured Irwin to better meet their needs, though most used it for several days first. Common resources to monitor were email, various news and sports Web sites, high traffic Usenet news groups, and the local weather.

Reaction was mixed on the use of audio. All but one user turned the audio alerts off or only used a simple beep, and the one user who did use it only used short sounds (under a second) even though Irwin provides sounds up to two seconds long. Reactions varied from "I didn't need it" to "It would drive me up the wall." While we feel that audio is not for everyone, if it is kept short and distinctive it can prove to serve its purpose for some people.
Most users did not use the navigation bar very extensively. They typically looked at Irwin only to see the most recent additions, i.e. those visible in the text boxes. One user noted that he could recognize a few patterns and occasionally would notice blocks of identical encodings together (indicating several emails or news postings by the same person) but would rarely click on them and browse them. The problem may be that the navigation bar is better suited for browsing and searching tasks than for awareness, or it may be that the users did not choose resources for which the navigation bar is best suited.

After using Irwin for several months, the users had many suggestions for resources that they wanted to monitor but could not with Irwin. The resources include Unix commands like lpq and finger and Web images like traffic and weather maps. The users wanted more flexibility over the way in which information is presented - not all resources fit in the list-based concept of the navigation bar. As we extend and improve Irwin, we are exploring new identification schemes and new communication mechanisms to allow the user to specify items of interest and to have the information delivered in the most appropriate manner.

Related Work

A significant amount of research has focused on the filtering and dissemination of information (Foltz & Dumais 1992, Frakes & Baeza-Yates 1992). However, far less work has been done in understanding how people need the information to be communicated. Many systems generate email or Web pages that still require the user to remember to check them. Other solutions have been developed for specific resources, but there is not always a direct application to a broader range of resources. We hope that the Irwin monitoring system will address these concerns by providing a configurable set of tools for monitoring interesting resources and staying aware of changes that occur to them.

The individual components of Irwin were influenced by prior research. Auditory cues have proven useful in both enhancing and replacing visual cues in user interfaces (Brown, Newsome, & Glinert 1989, Brewster 1994). Studies have shown that changing the appearance of icons can convey additional information about their use; for example, animated icons (Baecker, Small, & Mander 1991) convey more information about the functionality of tools in a tool palette than a static image. The navigation bar concept of encoding lines of data using graphical lines came from previous systems. Read wear and edit wear (Hill & Hollan 1994) represents lines of text with lines of pixels, where characteristics like length and color correspond to properties of the text such as the number of modifications. The SeeSoft (Eick, Steffen, & Sumner 1992) and RunView (McCrickard & Abowd 1996) software visualization programs represent code with lines of pixels where the length of the line can correspond to the length of the line or function, and the color can correspond to the author, module name, or last modification date. To our knowledge, our navigation bar was the first to use syntactic encodings, the first to fully leverage the scrollbar metaphor, and the first to empirically demonstrate that this type of encoding improves user performance in search and recognition tasks.

While many parts of the Irwin system have been researched individually, we feel that our true contribution comes in the integration and evaluation. We hope that the lessons we have learned have built on the work of previous researchers to provide another step towards understanding information awareness.

Conclusions and Future Work

Based on our experience with Irwin, we would like to discuss a few of the lessons we learned which should help in the future development of information awareness tools.

Irwin users were willing to sacrifice a little bit of space to increase their awareness of information resources. Even those who did not use Irwin cited reasons other than space limitations. While we do not expect that everyone will need awareness tools, it appears that there is a significant population that does.

When using Irwin, most users utilized some combination of feedback from auditory cues and icon changes to know when to check a resource. Though we provided auditory cues that were up to two seconds in duration, all of the sounds configured by our users were under one second, and most used only a simple beep. Longer sounds seem to be too distracting, and a simple visual change may suffice to maintain awareness. The navigation bar seems to be better suited for searching and browsing tasks than for general awareness, though users began to recognize a few patterns over time, and for certain situations (such as monitoring a course newsgroup or a listing of jobs) the navigation bar may yet prove to be essential.

Too often visualizations will provide complex graphical views of a data space but will make it difficult to see the actual data that is represented. Ideally, a visualization will provide a view that combines graphics and text dependent on the available space, the needs of the user, and the amount of information that needs to be shown. The confluent zoom allows the user to stay aware of the status of several resources but also to view details of a selected resource. By providing both focus and context in a compact manner, users can be free to focus more of their attention on other tasks.

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Developing Generic Interactive Learning Tools to Engage Students: The Text Analysis Object for Web and CD-ROM

David M. Kennedy[1], Albert Ip[2], Craig Adams[3], and Norm Eizenberg[4]

[1] Centre for Learning and Teaching Support, Monash University, Australia
email: david.kennedy@CeLTS.monash.edu.au
[2] Multimedia Education Unit, The University of Melbourne. Australia
email: a.ip@meu.unimelb.edu.au
[3,4] Department of Anatomy and Cell Biology, The University of Melbourne. Australia
email: craig.adams@whcn.org.au
email: n.eizenberg@anatomy.unimelb.edu.au

Abstract: This paper reports on research engaged in the design, development and evaluation of an innovative, interactive learning tool—for Web and CD-ROM. The learning tool is the text analysis object (TAO). TAO facilitates the development of text-based extended question-and-answer problems. Using TAO, a student is able to generate a more meaningful answer by articulating their understanding rather than merely recognising the lecturer's representation, as in multiple choice questions. TAO facilitates an iterative approach to knowledge construction. Feedback to the student is determined by using a key word and key phrase search, utilising a two-tiered, hierarchical feedback mechanism—distinguishing between concepts (major ideas or principles) and details.

A formative evaluation of the TAO is reported. The examples of TAO relate to questions developed for use in undergraduate medicine. However, the TAO is applicable to many other academic disciplines where there is a need to develop more complex understanding of specific content domains.

Introduction

The use of computer-facilitated learning (CFL) for Web and CD-ROM in higher education has increased considerably in the past five years. Considerable effort (academic, financial and time) has been invested in the development of courseware. However, insufficient effort has been made to develop pedagogically sound interactive learning tools that have the potential to engage students more actively in learning. If there are to be any lasting improvements in student learning outcomes and the success of computer-facilitated learning (CFL) there is a need to:

- embed sound educational pedagogy into courseware; and
- provide interactive computer-based learning tools, which are simple for content experts to implement in a variety of learning environments supported by CFL.

The development of the Text Analysis Object (TAO) is part of a wider program being undertaken at The University of Melbourne to develop simple generic Web-based and CD-based learning and evaluation tools (Kennedy & Fritze, 1998; Kennedy & Ip, 1998). Initially, interviews with academic staff from a variety of disciplines were undertaken. Responses indicated that an interactive learning tool that could elicit student responses of more complex knowledge (rather than merely require recognition as in multiple-choice questions (MCQ)) might have the potential to enhance student learning by providing more meaningful feedback for students. The TAO is intended to facilitate an iterative approach to learning, provide meaningful feedback, and require articulation rather than recognition of knowledge. The functional aspects of the TAO include:

- a text box into which students type short, text-based answers based upon a question item;
- a software engine (one for the Web environment and a second stand-alone version for CD-ROM) to search for key words or multiple versions of a phrase or phrases defined by the lecturer or content expert;
- the ability to provide appropriate and meaningful feedback to students; and
- access to expert answers and a representative student exemplar to questions for comparison and self-evaluation purposes.

Three perspectives guided the development of TAO. These perspectives involved:
- a constructivist view of teaching and learning;
- the needs and computer literacy skills of academic staff engaged in developing courseware; and
- the requirement for a student to link anatomical knowledge to a clinical perspective.

The pedagogical perspective adopted derived from a theoretical framework that links what is known about sound educational practice with the design of computer-based learning tools (design elements) for incorporation into computer-facilitated learning environments or interactive multimedia (Kennedy & McNaught, 1997). The analysis of text from student-generated answers was designed to engage students more actively in the learning process—a move away from the click-and-browse interface of many current CFL offerings. Initially, the feedback mechanism for the TAO was established by interviews with academic staff. The final mechanism was determined after meetings with student focus groups engaged applying anatomical knowledge in a clinical context. The students were in their first year of clinical practice (Year 4 of Medicine). A number of potential scenarios were constructed and a variety of feedback mechanisms evaluated. Typical comments from the students about the problems they encountered in their daily clinical practice include:

> ...the difficulty is knowing what is important and what is not important (anatomical knowledge) in making a diagnosis.
>
> I have forgotten much of what I learnt in first and second year anatomy. ... I find myself going home each night and relearning the important concepts (of anatomy).

The TAO facilitates the incorporation of feedback that links anatomical knowledge to clinical practice, and provides a numerical score (specifically requested by the students in order to establish a link to formal assessment). The feedback mechanism is intended to address the widely reported failure of students to link pre-clinical knowledge (e.g., anatomical knowledge) with the demands of being a successful clinician (Balla, 1989; Eizenberg, 1988; Eizenberg, 1991). The feedback mechanism is a key feature of the TAO, using a hierarchical structure to separate key concepts from minor details. Initially, the TAO software determines the number of key words or words or multiple versions of a phrase or phrases (as defined by the content expert) found in the text string typed in by the student. The concepts and details of the correct responses are then differentially highlighted and returned to the student. The student knows what parts of her answer are correct, and the relative importance of each correct response. The two tiers required the development of:
- TAO software to differentiate between important anatomical concepts and what were merely anatomical details (ideas not fundamental in clinical practice), and
- a model for writing questions which focused on anatomical concepts important in clinical diagnosis.

These led to the development of a schema for writing the questions, expert and student representative answers, key words and key phrases. The schema also guided the development of the authoring environment. Figure 1 (Fig. 1) is a screen capture image of student feedback during the evaluation process. Not shown, is the video clip (a simulated patient complaining of pain in the right side of the abdomen) that accompanies the text component of the question. With TAO, video, graphics and sound may be used with any question.

TAO is intrinsically a very simple system with no built-in intelligence—a strength and a weakness. This is in contrast to other text analysis systems, for example, Latent Semantic Analysis (Landauer, Foltz, & Laham, 1998b). The Intelligent Essay Assessor (IEA) is one such tool that uses LSA—relying on the ability of the software to measure the coherence of text by comparing the degree of semantic relatedness of adjacent text segments—from parts of sentences to paragraphs (Landauer, Foltz, & Laham, 1998a).

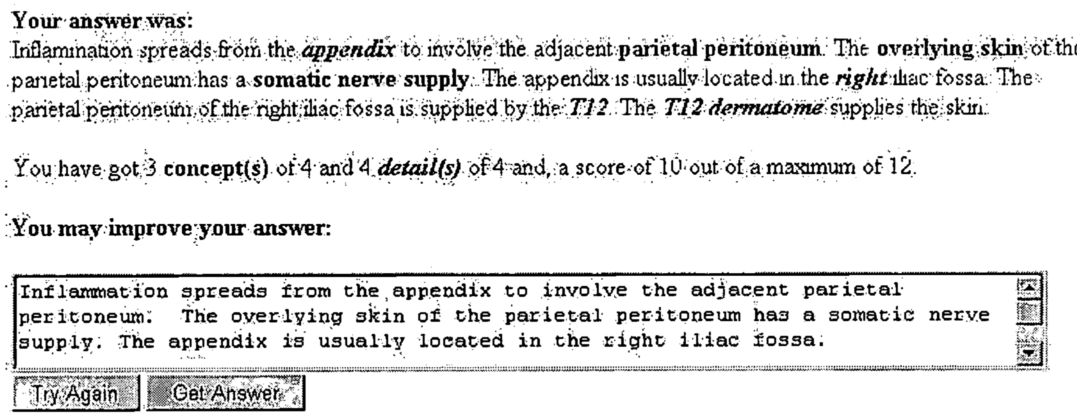

Figure 1: The Web version of TAO: Hierarchical feedback linking clinical practice and anatomical detail

The accuracy of the IEA in the grading of student essays is comparable to that of human markers. However, the training of the IEA requires a very intensive diagnostic process undertaken by experts, and access to a large number of exemplars of relevant subject material (e.g., up to 30,000 articles). The IEA makes no sense of word order, syntactic relations, or logic (Landauer *et al.*, 1998b, p. 261). In clinical diagnosis, word order and logic are critical. The TAO is designed to provide formative and (limited) summative feedback to students. It is not intended for use as an assessment tool. Student learning is enhanced by engaging students in a reflective process. In answering a question a student must address the following: How many of the major concepts have I got correct?; Are the concepts I articulated actually the ones required for a correct clinical diagnosis?; How 'good' is my answer compared to the two representative answers provided?, and, How does my answer relate to the clinical perspective presented (e.g., in the accompanying video)? TAO's strengths are:

- its relative simplicity of use by content experts,
- the ability to focus on important concepts specified by the educational needs of a particular content domain,
- the hierarchical nature of the feedback provided (concepts and details), and
- the provision for an iterative approach to learning as the student moves towards a final answer.

A content expert using TAO also has the ability to incorporate other media, video clips, graphics and sounds into a question. Video clips may be used to situate the learning in a clinical context. The major weaknesses of developing a system using TAO are the need

- to design the questions carefully, and
- a pre-emptive approach (Bain & McNaught, 1996) to appropriately express key words and phrases.

A Functional View of TAO

The basic functionality of TAO requires a:

- text field into which a student can type an answer to a question,
- software engine to analyse the student text and provide meaningful feedback,
- method of displaying an expert answer, and
- simple-to-use authoring environment.

Initially, the TAO was created as a server-side object—that is, the software engine for the tool was located on a Web-server. This decision derived from the need to have a short development time, core functionalities that could be developed quickly and tested, and a tool that could be easily maintained. Design of the Web authoring environment was inherited from the OXYGEN software engine (Ip, 1998). OXYGEN also supports Learning Evaluation Online (LEO), an online evaluation tool used in the formative evaluation of TAO (Kennedy & Ip, 1998). The second version for CD-ROM has been prototyped as a Macromedia Director® object for the project, *Demystify*—which focuses on clinical practice in undergraduate medicine.

The structure of the authoring environment was critical because the expected users of TAO are lecturers—who often have only limited computing experience. Our prior experience indicated that a forms-based approach was appropriate. The authoring environment consists of input fields for the:

- reference code for the question,
- question stem,
- key words and multiple versions of a phrase or phrases based on an important concept or concepts,
- key words and multiple versions of a phrase or phrases based on an detail or details,
- mark to be awarded for each concept (major idea) and detail (minor idea), and
- expert answer and an exemplar student answer.

Experience has shown that content experts with minimal computing skills can format questions easily for use with the TAO. The structure of each question required the:

- separation of important (clinical) concepts from (anatomical) details,
- development of a number of alternatives for key words and phrases, separated by the pipe '|' symbol, and
- organisation of the expert answer into point form which clearly showed the concepts and details (a stated requirement from the students in the focus groups).

A question used in the first formative evaluation is shown in Table 1. The CD-ROM version of TAO will be used in the *Demystify* project and the Web version in a variety of courseware in the Faculties of Medicine at The University of Melbourne and Monash University.

Formative Evaluation

Formative evaluation of the Web version has been completed. The student responses to the use of TAO were generated by the 'think-aloud' approach, researcher notes, and an online survey (Likert-style and free text response) using Learning Evaluation Online (LEO). One of the surprise results of the evaluation process was the considerable discussion, debate and collaborative effort engaged in by students in order to arrive at an answer, or succession of answers. The students found using the TAO straightforward. In each session students were asked to complete approximately half the questions (4 to 6). This led to the unusual phenomenon of the majority of students requesting to stay to complete the remaining questions at an adjacent computer (which they subsequently did). The formative evaluation indicated a strong acceptance by students of the TAO as an effective learning tool. Representative written comments from the online survey asking about the best features of TAO are:

> It is very clinically oriented which is brilliant since books do not often highlight important principles.
>
> ... the distinctions between concepts and details in the question are critical, therefore very relevant.
>
> The fact that we could type in our own answers and for the program to analyse what we got right instead of us choosing from a number of given answers.

The use of pairs of students enhanced the learning experience by promoting a collaborative approach. Students were strongly engaged in debate and argument about the inclusion or exclusion of anatomical concepts and details. Most pairs of students tended to refine the first attempt a number of times before having the response analysed. The concern expressed by some academic staff that a student would merely access the expert answer almost immediately was unfounded for two reasons.

The first reason was student motivation—when asked why they didn't look at the expert answer immediately, students stated that doing so was a 'waste of time' because it wouldn't help them learn. The second reason is more pragmatic—TAO requires a student to click on a *Submit* button before being provided access to the *Get Answer* button. A similar lack of concern was expressed in regard to the lack of a spell checking mechanism—

they believed they should know how to spell the terms. Not all comments were positive and some of these responses have resulted in changes in functionality of the TAO.

In response to 'What was the worst feature of this multimedia program?', students stated the following.

> No indication of how much is expected in answering a question.
>
> Having to sift through (expert) answers to find what you hadn't included (in your own answer).
>
> Maybe at times being too pedantic about details.

Q: 0004	In appendicitis, after initial pain has been experienced, the pain typically shifts to the right iliac fossa. Explain the anatomical basis for this	
Expert answer	Concepts: Inflammation has spread from the appendix to involve the adjacent parietal peritoneum. The parietal peritoneum and the overlying skin have a somatic nerve supply. Somatic pain is usually well localised as it is typically referred to the overlying skin.	Details: The appendix is usually located in the right iliac fossa. The parietal peritoneum of the right iliac fossa is supplied by the right twelfth thoracic spinal nerve. or T12 or subcostal nerve. The skin of the right iliac fossa is supplied by the T12 dermatome or by the right twelfth, T12, subcostal nerve
Keywords and/or phrases	Concepts parietal peritoneum somatic nerve supply| somatic nerve| somatic pain overlying skin referred pain| referred| refer	Details twelfth thoracic spinal nerve| subcostal nerve| T12| twelfth thoracic appendix T12 dermatome| dermatome right

Table 1: A template and exemplar question for using TAO

In response to 'Any more comments or suggestions for improvement?', students stated the following.

> Providing hints at second attempts and .... having a help file with a list of anatomical terms...
>
> Just enhance the text analysis flexibility– sample a wide proportion of possible answers.

In addition to the extended comments (above), the student responses to bipolar Likert-style questions were analysed. The mean responses are shown in Table 2 (Tab. 2). The responses were scored: 1, strongly disagree; 2, disagree; 3, no opinion; 4, agree; and 5, strongly agree.

Likert-style question	Mean
The TAO helped emphasise important and relevant concepts.	4.7
The TAO helped identify key concepts and provided insights.	4.6
The TAO helped provide feedback which was meaningful to me.	4.3
As a result of using this multimedia:	
I was stimulated to reflect on what is important for me to understand.	4.4
my intention to achieve an understanding of this subject was enhanced.	4.4
Overall I found this multimedia program to be worthy of extension to develop new modules with similar uses of the TAO.	4.7

Table 2: Example student responses to likert-style questions: Web-based TAO

In response to these comments two changes have been made to the TAO software engines. The mark for each question is displayed with the question stem to provide a guide for the relative complexity of the answer required. The second change is more fundamental. The TAO is to be incorporated into courseware—providing access to hints and/ or online help.

Future Development

A new collaborative project, Interactive Qualitative Questions: IQ^2, has been commenced jointly at The University of Melbourne and Monash University to develop the two versions of TAO further. The TAO is being incorporated into both Web-based and CD-ROM courseware—*Anatomedia* (designed to support the learning of anatomy), *Demystify* (which focuses on clinical practice), The Virtual Radiography Room (a simulation of radiography practice), and Gastro-intestinal Medicine courseware. In response to current student feedback a number of changes will be made. One change has already been indicated (a mark). Both versions of TAO derive from courseware based on components (Ip & Canale, 1996; Ip, Canale, Fritze, & Ji, 1997). Other changes will be:

- improvements to the authoring environment by greater integration of video and sound to provide multiple perspectives for the questions, and
- generation of each question in a separate window.

The formative and summative evaluation of student learning outcomes in both institutions for both the Web and CD-ROM versions of TAO in the four projects will continue in 1999.

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CourseMaster: Modeling A Pedagogy for On-line Distance Instruction

Benjamin Bell
Department of Human Development
Teachers College, Columbia University
United States of America
benjamin.bell@columbia.edu

Danielle Kaplan
Communications, Computing & Technology
Teachers College, Columbia University
United States of America
danielle.kaplan@columbia.edu

Abstract: As attention becomes increasingly focused on distance education, in the public eye and within the academic community, a sense of urgency to develop on-line course offerings is taking hold among institutions that wish to be responsive to student needs (real or perceived) and that do not want to be "left behind" as peer institutions tool up for distance instruction. With the host of software tools available, adapting courses to the on-line learning environment does not pose insurmountable technical obstacles, and can be almost routine. What becomes a challenge is preserving the original value of the instructional design and adapting the pedagogical nuances of a course to best leverage the modalities of on-line instruction. This paper illustrates how a graduate level course at Teachers College, tailored for face-to-face instruction, was adapted for distant learners, and how the instructional design was captured and replicated by a web-based distance education authoring tool.

Introduction

Recently, Teachers College, Columbia University expanded the boundaries of its campus by offering on-line distance learning courses for the first time. Three graduate courses, in three different areas, were selected for this pilot initiative: Computer-Mediated Communication, The Teaching of Writing, and Instructional Design of Educational Technology. The courses, previously designed for the classroom, were adapted to on-line settings, and in the spirit of experimentation, each course adopted a different development path. We will discuss the design of the course in Instructional Design of Educational Technology, which poses several challenges to the distance format, among them, its emphasis on discussion, the importance of technology demonstrations, and the centrality of group project work. We also summarize the evolution of the CourseMaster Authoring Environment, a database-driven tool that is derived centrally from a model of distance instruction that guided the construction of the original course application.

Goals

The goals of this project were to build a reproducible distance learning model, within which rich classroom interactions among participants can be replicated, and to shed light on potential obstacles to the success of this approach. We were guided in part by our previous distance learning research that calls for a resource space, discussion space and collaboration space as components of successful computer-supported distributed learning (Bell & Meyer,1997). In the pilot course, we focussed on specific design techniques for fostering group interaction. We developed several facets of the course with community-building in mind: a student database where participants would share personal profiles; a suite of technology demonstrations and corresponding assignments aimed at getting students to share reactions to those demonstrations; a terminal project that engaged teams of students in remote collaboration; and regular discussion and chat sessions to foster and sustain whatever communal momentum had been achieved. The creation and implementation of Instructional Design Online (as the distance version came to be called) presented an opportunity to invent a web-based learning environment, adapt an onsite class to an on-line course and capture its design in a mold, thus providing a test-bed for studying learning at a distance.

Pilot Course Design: Instructional Design Online

Instructional Design of Educational Technology is a graduate class that surveys contemporary frameworks for intelligent learning environments and that engages students in designing and executing collaborative projects (e.g., an interactive web-based environment, stand-alone instructional multimedia, etc.). The class thus emphasizes learning by doing. In order to support this approach through computer-mediated instruction, the course site includes five sections, each of which can be reached by using a drop-down menu: *Information Desk*, *Course Central*, *Instructor's Corner*, *Student Lounge*, and *Help Center*. Each section has its own sub-menu for the sites located within that section.

The Information Desk includes an overview of the course, an orientation session, a course outline, and registration information. The overview offers a summary of the class and a list of required readings. The orientation is intended to welcome students, guide them into practicing tasks common to an on-line class and prepare them with the tools necessary for exploring the learning environment. Initial assignments are designed to engage students in Internet communication. Orientation assignments include viewing a video welcome from the instructors (Fig. 1) and creating a student profile.

Course Central consists of a syllabus, on-line demonstrations of educational technology, course lecture slides, and course assignments. The syllabus is divided into topic-specific modules, each including links to the corresponding lecture slides, assignments for the week and related technology demonstrations. The readings for that module are available via hypertext links to external web sites.

Web-based educational technology demonstrations represent an important element of this course. The principles and frameworks discussed in the readings can remain largely static or abstract in the absence of applications of those ideas in the form of interactive illustrations. To preserve this central aspect of the course, we adapted several works-in-progress at Teachers College for on-line viewing, including Wx-Brief (Bell, Vaughn & Reibel 1997), Aviation Story Archive (Bell, Gold & Kaplan, 1998), and the Virtual Hall of Fame (Zirkel, Bell & Gold, 1998). Each Demonstration is accessible on-line (Fig. 2) and supplemented by an assignment in which students share observations and critiques of the demonstration.

Lecture Slides are available in modules, each consisting of slides that can be navigated in succession or through direct links. Assignments are designed to encourage students to explore technology tools and Instructional Design theories, and to integrate them in discussion responses and project creations. Assignments range from regular responses to issues raised in the reading to creating interactive exemplars of concepts treated during the course.

The Student Lounge includes a database of student profiles, a meeting room and a student projects area. The Student Profiles section facilitates the distribution and sharing of individual profile and contact information. A participant database (Fig. 3) receives profile forms submitted by the student, and permits the browsing and searching of participant profiles, pictures and contact data. Profiles include direct links to student mailboxes and world wide web addresses, personal interests, and academic and professional histories. The instructors' profiles and office hours are in the Instructors' Corner. The profiles include Instructor academic background, links to personal web sites, and office hours (which are conducted face-to-face, by telephone, via text chat, or using audio conferencing).

The Meeting Room, supporting synchronous (chat) and asynchronous (bulletin board) interaction, is the primary communication area. The chat room permits live scheduled group discussions, including multiple simultaneous one-to-one private chats, about topics related to course content, assignments and group projects. Class-wide chats are transcribed and published on the course site. The discussion room supports group communication through individual message postings.

Early in the course, students are asked to form groups and to begin proposing final projects. As the semester progresses, students are asked to prepare incremental reports, such as a storyboard, documenting their progress in the final project. The Student Projects area centralizes information regarding final projects, the culminating product of the students' experience in the course. Suggestions (in the form of online technology demonstrations) are offered as potential group projects, though students are invited to propose their own ideas as well. A project database collects and publishes information about project group members, member email addresses, and project URLs, so that group members and projects are easily accessible.

Formative Evaluation

Participants

The course was offered during the spring, summer and fall semesters of 1998 and is currently in session for the spring, 1999 term. Eight students enrolled for the spring semester, 7 students for the summer, and 17 for the fall. In each semester's class, more than half of the students registered for credit. All of the students in each semester had completed or were pursuing either a Masters or Doctoral degree. Most of the students registered for credit were part-time students who work full-time as either classroom teachers or technology professionals. Several of the non-credit students were faculty at other institutions who were interested in exploring examples of distance learning courses. Students were physically situated in locations throughout the U.S. (with some international participation from Japan and Brazil).

Methods

Pre- and post-course surveys and scheduled chat interviews were used to gather qualitative information about on-line students and on-line student experiences in the pilot course. Chat sessions, discussion postings and group projects served as additional evidence documenting student performance. The objective of this formative evaluation was to learn more about how students made use of the tools we supplied with the course, the extent to which those tools furthered the students' capacity to engage in the class activities, and to explore potential research questions for further studies. The study did not attempt to measure learning outcomes beyond a qualitative assessment of their productivity as required for grading purposes. Our evaluation was guided in part by the expectation that understanding the learning needs of students is crucial to successful on-line course experiences (Reid, 1996; Warren, 1996; Willis, 1995). Pre-course surveys were aimed at gauging student backgrounds and skills and their reasons for enrolling in the course. Post-course surveys were aimed at gathering student perceptions about their experience in the course and the design of the learning environment.

Results

Computing ability and exposure to the Internet varied widely among incoming students. In each class there were individuals who reported that they did not feel confident in their computing skills, as well as others who reported that they were comfortable with a variety of computer and Internet applications. Variation in computer literacy also became evident as the semesters progressed. Many of the individuals who had expressed a lack in computing skills moved through the syllabus at a much slower rate and seemed to be less involved in group communication. There were also individuals who came in with weak computing skills and gained proficiency at a rapid rate. During one semester, a vision-impaired student participating in the course provided valuable feedback on the extent to which our course site accommodates visually-impaired students in accessing information and navigating the site.

The Discussion room was the most active component of the courses in each semester, primarily used for discussion about course assignments and scheduling. Assignment postings took on a quality that seemed to be a cross between written language and spoken conversation, with ideas expressed in a blending of informal and formal language styles. A large proportion of the postings in the discussion threads were responses to assignments or questions from the Instructor or Teaching Assistant. Students did not begin to initiate spontaneous postings until later in the semester. The discussion room was not used for dialog with other students until the Instructor suggested that students respond to the postings of other students. Once this suggestion was made, peer-to-peer interaction became more frequent and substantive.

Statements from students indicate that communication among students also took place via private email messages and by telephone. While much of the communication from the Instructor and Teaching Assistant occurred in the public communication space, spontaneous communication from students to instructors usually took place in private email or telephone messages. Email messages and telephone calls from students to the Instructor or TA were primarily about administrative and technical issues, such as course credit, and only occasionally contained content related communication. Instances of project related mail and phone calls did occur just before the final projects were due during the spring and summer semesters.

Students in the spring and summer semesters did not frequently meet in the Chat Room unless the Instructor had scheduled the chat. Students in the fall course appeared to be making more use of the Chat Room for peer-to-peer communication. One fall semester group met in the Chat Room for several hours a week. The main differences between groups in the fall course and groups in the spring and summer appeared to be group size (the fall class had larger groups) and individual computing ability (the fall class had more individuals with strong computing ability). In each term, the Chat Room was used on just one occasion as an entire class (time-zone differences caused scheduling difficulties). Not all of the students attended the scheduled chats. For the participants who did attend, these sessions were productive. Several students mentioned that Chat Room discussions were most like the communication that takes place in the classroom. All of the Chat participants spontaneously shared thoughts and ideas.

Not all of the individuals in the spring and summer courses completed a final group project. The group projects that were completed were of high quality. There had been some concern about whether students in the on-line class would have access to the same materials as students in the classroom, such as commercial, licensed authoring software, so it was decided that on-line student projects would be created with publicly available materials. Despite the potential difference in student resources, the on-line students' final project was comparable to final projects created by students in the classroom. Students in both online and in classroom courses produced original technology-based learning environments that showed some integration of theories discussed in the course.

Student comments suggested that they appreciated the variety of delivery methods and information resources provided, such as lecture notes, public readings and discussion threads. However, they also expressed frustration in accessing these resources. Several students mentioned that they had consistently had connectivity problems and problems during chat sessions and in downloading plug-ins and other course information. Advanced components took too long to download or made their computer crash. These students indicated that much of the problem was with their hardware. Suggestions were made to make graphics, video and other hard to access information available through other means. Generally, the comments acknowledged the importance of speedy and reliable connections and up-to-date hardware. Also, based on the comments made during the final chat session in which students were directly queried (in the absence of the instructor), students appeared overwhelmed by the technical requirements combined with the content of the course. These students did not feel that their knowledge of computer technology supported their learning needs and suggested a hands-on prerequisite, which would enable students to learn the technology apart from the content. All students who have completed the course thus far responded that they would consider taking another distance learning course.

Discussion

Our exploratory findings provide some information about the needs of distance learners, how our design functions in practice, and how to focus our future research efforts. While many distance courses are promoted to provide flexibility and convenience, they may in fact be more time consuming than classroom courses, depending upon the skill level and resources of individual participants and the quantity of participants. For students who were not comfortable with Internet communication or had inadequate resources, downloading data and keeping up with communication was more time consuming than they had expected. It is clear when examining both student needs and instructional design that explicit information regarding minimum and suggested hardware and software requirements be made available to students.

There appear to be both similarities and differences in student participation in classroom and distance learning environments. Similarly to on-site classes, students who were not taking the course for credit were not as active as students who were enrolled for credit. In contrast to on-site classes, students in the on-line class did not seem as accountable for their work. On-line students did not complete all of the assignments and did not attend all the scheduled meetings. Overall, the on-line students in this class required more guidance and imperatives. On-line students did not seem as self-disciplined, perhaps because they did not have physical access to the Instructor or Teaching Assistant. Despite the challenges involved in this on-line setting, students were able to utilize the tools, navigate and participate within the learning environment. Most students more than sufficiently completed the entire course on-line.

These preliminary studies have been helpful in our efforts to develop more systematic means of investigation. Based on student comments and student participation in the spring and summer courses, a new set of database-driven pre-course and post-course surveys was developed and distributed in the fall semester online and classroom courses. Survey questions are designed to capture information regarding student skill level, reasons for taking the course, predictions about the learning outcomes and challenges in on-line courses versus the learning outcomes and challenges of students in classroom courses, and perceptions of student-professor and student-student relationships. Questions in the new surveys invite both open-ended (as in previous surveys) answers and precalculated answers (based on open-ended answers from previous semesters). The overall goal of this new addition to the design of the course is to provide an improved structure for examining on-line student learning, evaluating course design, discovering student perceptions about on-line learning in comparison to classroom learning and gathering preliminary evidence about whether or not intimacy levels among individuals within a distance learning environment are different than intimacy levels among students in a classroom environment.

Bringing the Model to Life

Upon building what proved to be an effective course design given current technological conditions, we then successfully crafted CourseMaster (Fig. 4) by abstracting the original course and implementing that abstracted model as a set of relationally-linked database templates. The result is a sophisticated courseware authoring tool that not only renders the course production process less mechanically burdensome, but also adheres to (and derives its power from) this specific design model. Because it is created in a fully web-compliant database environment, CourseMaster can be used remotely by authors, and design commitments are immediately reflected in the materials published on the web. We can now create a new on-line course modeled on this design, within any subject area, with relative ease.

CourseMaster presents us with three research opportunities. First, comparisons can be made using the same design among different content areas. Second, aspects of group interaction across all content areas and design frameworks can be explored with the use of survey evaluation databases. Third, questions can be asked about instructional design in terms of particular on-line learning components, such as chats, discussion rooms and visual aids, by building identical courses that vary only in terms of the use of particular components.

Conclusion

One common deficiency among distance instruction materials we have encountered is the absence of an explicit instructional approach (Bell & Meyer, 1997). This paper described a distance courseware design in which we adopted a pedagogy that emphasizes peer interaction and group collaboration. An overall objective of this research is to develop frameworks for distance course design, appropriate for given subject domains, that preserve the positive elements of face-to-face instructional designs while introducing new strategies that take advantage of the properties of desktop telecommunication and web-based interchange. Our experiences with the design of Instructional Design Online have suggested some positive aspects of on-line distance learning and have indicated some directions for future research and course development. A principal conclusion is that successful distance learning must be at least as (if not more) firmly grounded in communication as traditional classroom instruction. Our success with the use of student profiles, collaborative project work, and extensive discussion lend supports to the claim that distance learning is effective to the degree that it creates and maintains learning communities that support knowledge construction. The emergence of collaborative tools that allow students to create and refine knowledge artifacts on-line is encouraging (Harasim, Calvert & Groeneboer, 1996). Web-based communications technologies will no doubt continue to evolve to support more real time communication and a more seamless interface among communication, collaboration, and information-gathering resources (Harasim, 1990). Flexible tools, such as CourseMaster, that help course designers to organize their information and incorporate emerging communication and collaborative learning tools support an extension beyond the current model of an HTML template for didactic presentation, toward virtual communities of learning.

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CHANGES IN STUDENT ATTITUDES IN A COMPUTER ENRICHED ACADEMIC ENVIRONMENT: REPORT FROM A LONGITUDINAL CASE STUDY

Ananda Mitra
Department of Communication
Wake Forest University
USA
ananda@wfu.edu

Abstract: This paper reports that longitudinal exposure to a computerized enriched learning environment might not necessarily change the attitudes toward computer enhanced learning unless the development of the computerized enriched environment is supplemented by the fact that every member in the environment is provided with the tools for connecting with the environment. In this study, students without the tool never felt the empowerment of access and so they continued to maintain either a negative attitude, or did not alter their attitudes in a positive way even when placed in a networked and computer enriched environment. On the other hand, the students who entered the environment with a personal laptop computer and felt immediately connected to the environment.

INTRODUCTION

Based on the existing evidence on the use of computers in the higher education environment and in view of the increasing trend of all-out computer enrichment programs in academic institutions we pose the following question: 1.What are the changes in attitudes towards the use of computers in a higher education environment that is computer enriched? This question attempts to address the way in which wide-scale and long-term exposure to a computer enriched environment can alter the overall attitude towards the application of technology in higher education. As has been argued elsewhere, it is, however, important to acknowledge the context within which the technology is being applied (Ashley, 1992; Ahola-Sidaway, 1990; Bender, 1995; Fey, 1993; Goulet, 1994; Hettinger, 1995; Mitra, 1994; Mitra and Hullett, 1997).

METHODS AND SAMPLE

The study was designed as a longitudinal survey spanning five years with the first year being the baseline year. In the Fall of 1995, Wake Forest University entered into a partnership with IBM to make the institution computer enriched. In this case, the process of enrichment involved several different initiatives including extensive networking of student residence halls, classrooms, the library and most office buildings as well as providing all incoming students (beginning the Fall of 1996) with an IBM ThinkPad computer. This strategy ensured that by Fall of 2000 every student at the University would be equipped with mobile computing that would provide easy access to a local area network and then the Internet. When this decision was ratified, a survey design study was also initiated to track the changes in the way the different elements of the institution (faculty, staff, students, etc.) react to the computer enrichment. This analysis reports from three years of the study to answer the two questions posed earlier.

The survey design utilized a questionnaire that was constructed after extensive use of focus group discussions to explore and uncover the various issues surrounding the computer enrichment process at the University. Focus groups were conducted with students who belonged to the "ThinkPad Program" (henceforth referred to as the Program) as well as the students who were not direct beneficiaries of the Program but could utilize the connectivity and technology advancements in the classrooms. A survey instrument was developed and was used in the Fall of 1995 when only 100 pilot students were part of the

Program, in Spring 1997 when all the First Year students were part of the Program and in Spring 1998 when all First and Second Year students were part of the Program. The three administrations thus covered the 1995-1996 school year (henceforth referred to as Year 1), the 1996-1997 school year (Year 2) and the 1997-1998 school year (Year 3). Given the way the enrichment process was designed, Year 1 included only 100 pilot students who had a personal ThinkPad and the University was barely networked. In Year 2, nearly 90% of the university was networked and all the Freshmen and 100 Sophomores had ThinkPads and the Juniors and Seniors did not have personal standardized mobile computers issued by the University (such students who were not a part of the ThinkPad program is referred to as "legacy" students later in the paper). Finally, in Year 3 all Freshmen, all Sophomores and 100 Juniors owned ThinkPads while the remaining Juniors and all Seniors were considered legacy students. The overall composition of the three groups are summarized in Table 1.

Table 1: Composition of the samples for Years 1, 2 and 3

GENDER	Year 1	Year 2	Year 3
Male	53%	43%	43%
Female	47%	57%	57%
SCHOOL YEAR			
Freshmen	32%	36%	54%
Sophomore	25%	24%	27%
Junior	20%	19%	18%
Senior	22%	21%	0%*
MAJOR			
Sciences	23%	25%	22%
Math	2%	4%	3%
Fine Arts	3%	2%	3%
Business	15%	22%	15%
Liberal Arts	13%	16%	16%
Social Sciences	17%	19%	22%
Undecided	17%	12%	19%
Other	11%	N/A	N/A

* The Seniors were not sampled in the Year 3 survey

Note: The N/A in Columns 2 and 3 refers to the fact that the question was not asked in Years 2 and 3

RESULTS

An ONEWAY-Anova measure was used to test for differences between groups and Scheffe's post-hoc test for homogeneity was utilized to identify the specific groups that were significantly different. The results indicate that there were more significant difference in attitude between Year 1 and Year 2 as compared to Year 2 and Year 3. As shown in Table 2, the results show that there are significant differences in the way the students expressed.

Table 2: Changes in attitude mean of all students from Year 1 to Year 3

Item	Year 1	Year 2	Year 3
Use of technology makes learning easier	3.5 (1391)	3.4 (469)	3.5 (271)
I prefer to take classes where I can get to use a computer	2.9 (1392)	2.9 (474)	3.0 (271)
I feel comfortable using a computer	3.6* (1392)	3.8* (469)	4.0* (271)
I have a certain apprehension about computer use	2.8* (1388)	2.4* (469)	2.2 (270)
Computers in teaching makes the learning impersonal	3.2* (1392)	2.9* (472)	2.7* (271)
Computer use increases the college work load	3.1 (1392)	3.0 (474)	3.0 (271)
Computers are effective for communicating wit faculty	3.3* (1400)	3.6* (472)	3.8* (271)
Communicating with professors by e-mail is generally gratifying	3.4* (1396)	3.7* (472)	3.9* (272)
Computers enable me to interact more with professors	3.0* (1393)	3.4* (464)	4.3* (266)

These differences include:

1. increasing comfort with the use of computers,
2. felt increasingly less apprehensive with the use of computers,
3. were less concerned that computers in teaching was making the teaching process too impersonal,
4. felt that computers enabled them to interact more with teachers,
5. felt that computers were effective for communicating with teachers about non-course related material,
6. felt that communicating with professors with e-mail was generally gratifying.

The question of attitude change was also explored by comparing specific groups of students and the changes/differences in their attitudes toward the use of computers in education. The first comparison was conducted between the Year 1 first year students, the Year 2 sophomore students and the Year 3 juniors. This group represents the legacy students who entered the University at the time when the enrichment initiative began. They did not feel the impact of the Program but were exposed to the changing technological ambience of the University. They had the opportunity to reap the benefits of a standardized computer network on campus. At the same time, they were exposed to an altering pedagogic condition where the faculty were increasingly "computerizing" the curriculum and introducing the use of computer mediated communication as a significant element of their teaching process. The groups were compared using an ONEWAY-Anova and the Scheffe's post-hoc test of homogeneity. The results indicate that the Year 2 Sophomores, and Year 3 Juniors felt that the use of computers did not make the learning process easier. The Year 1 Freshmen reported a mean of 3.6 (n=449) in responding to the item, "increased use of technology makes learning easier," while the Year 2 Sophomores reported a mean of 3.2 (n=110) and the Year 3 juniors reported a mean of 3.1 (n=48). While the responses of the Year 2 Sophomores and Year 3 Juniors were not significantly different, both of those means were significantly different from the mean response of the Year 1 Freshmen ($p<0.05$). At the same time, the Year 3 Juniors expressed a significantly more positive feeling that computers enables them to interact with their teachers, reporting a mean of 4.2 (n=48), as compared to the means of 3.2 (n=107) for the Year 2 Sophomores and the mean of 3.2 (n=448) for the Year 1 Freshmen.

Another comparison was conducted between the Year 2 Freshmen and all the other Year 2 students. This test represented a comparison between the ThinkPad students and the legacy students in Year 2. The comparison was conducted with the use of a t-test statistic with Levine's test of equality of variance. Significant differences ($p<0.05$) were observed here with,

1. the ThinkPad students feeling that the introduction of computers makes learning easier,
2. the ThinkPad students preferring to take classes where they could use the computer,
3. the legacy students feeling that computers can make the learning process too impersonal,
4. the ThinkPad students feeling that computers are effective for communicating with faculty about non-course related work,
5. the ThinkPad students feeling that communicating with teachers by e-mail is generally gratifying and
6. the ThinkPad students perceiving that computers enable them to interact more with teachers.

There were, thus, several instances where there were significant differences between the first group of ThinkPad students and all the legacy students.

While these tests represent the differences between legacy and ThinkPad students, it was also considered important to compare similar groups of ThinkPad students. The first test included an independent sample t-test with Levine's test for equality of variance. The Year 2 Freshmen, who composed the first batch of ThinkPad students was compared to the Year 3 Sophomores who represented the same group after a year's exposure to computerized instruction as well as after one year's use of the ThinkPad. There was only one significant difference observed in this comparison with the Year 3 Sophomores reporting a mean of 4.3 (n=71) in response to the item, "computers enable me to interact more with teachers," as compared to the mean of 3.7 (n=166) for the Year 1 Freshmen. A similar comparison between the Year 2 Freshmen and the Year 3 Freshmen revealed that the only significant difference between the first and second batch of ThinkPad students was that the second batch felt that computers enabled them to interact with teachers more than the first batch of ThinkPad students. The second group reported a mean of 4.3 (n=139) as compared to the Year 1 Freshmen who reported a mean of 3.7 (n=166). At the same time, the Year 3 Freshmen were not significantly different on any attitude measure from the Year 3 Sophomores. There were thus significant differences in attitude over the three years as well as across different groups of students over the three years. The specific areas of difference are summarized in Table 3.

Table 3: Summary of Findings

Significant changes in attitude for all students

Attitude Items	Pilot year to First year of computerization (1st batch of TP students on campus)	First year of computerization to second year of computerization (2nd batch of TP students on campus)
I feel comfortable using a computer	More comfortable	More comfortable
I have a certain apprehension about computer use	Less apprehensive	No Change
Computers in teaching makes the learning impersonal	Less concerned	Less concerned
Computers enable me to interact more with professors	More enabling	More enabling
Computers are effective for communicating wit faculty	More effective	More effective
Communicating with professors by e-mail is generally gratifying	More gratifying	More gratifying

Significant changes in attitude for legacy students

Attitude Items	Pilot year to First year of computerization (1st batch of TP students on campus)	First year of computerization to second year of computerization (2nd batch of TP students on campus)
Use of technology makes learning easier	Less easy	No Change
Computers enable me to interact more with professors	No Change	More enabling

Significant Changes in attitude of ThinkPad students

Attitude Items	First year of computerization to second year of computerization (2nd batch of TP students on campus)
Computers enable me to interact more with professors	More enabling

Significant differences between ThinkPad and legacy students observed in Year 2

Attitude Items	ThinkPad Students	Legacy Students
Use of technology makes learning easier	More easy	Less easy
I prefer to take classes where I can get to use a computer	More preferable	Less preferable
Computers in teaching makes the learning impersonal	Less concerned	More concerned
Computers enable me to interact more with professors	More enabling	Less enabling
Communicating with professors by e-mail is generally gratifying	More gratifying	Less gratifying

Significant differences between first batch of ThinkPad students and second batch of ThinkPad students observed in Year 3

Attitude Items	First batch	Second batch
Computers enable me to interact more with professors	Less enabling	More enabling

LONGITUDINAL PERSPECTIVES

Our results suggest that all the three elements - attitudes towards computers in general, the role of computers in teaching and the way computers facilitate the communication process - tend to become more favorable as an institution makes itself computer enriched. As demonstrated in the case of the overall student body composed of the legacy and the ThinkPad students, there is indication to suggest that the mix of students tended to become more positive towards the way in which computers could impact their college experience. Overall, the students became more comfortable with technology, were less apprehensive toward computers and were less concerned that the introduction of computers in teaching could make the learning process too impersonal. Indeed, the overall student body agreed that computers can positively impact the way in which students and teachers can interact and such interactions can be quite gratifying. The overall student body were not overly concerned over the ways in which computers could alter the learning process, and student opinion about the effects of computers on college workload did not change with exposure. In many ways, the general student body composed of the students with personal machines and those without the machines all felt that the computer was an expected and "natural" development in the pedagogic process and thus the students expressed a desire to use computers in classes. Even if the students did not change their opinion about the way in which computers can make leaning "easier," they appeared to agree with the statement that computers could make learning easier. Over the length of the study, the students felt that the use of computer in the college environment can be perceived to make the process of learning easier.

CROSS-SECTIONAL PERSPECTIVES

The cross-sectional perspective looks at the findings from the point of view of differences between the students in any particular year, or the differences between students of similar characteristics over a couple of years. This analysis demonstrates that the legacy students are less favorable than the ThinkPad students in nearly every attitude towards computer aided instruction. The legacy students who realized that they would not benefit from the enrichment that they were witnessing around them were expectedly more concerned about the utility of the technology in the teaching environment and less convinced that computers will significantly alter the ways in which teachers and students can communicate. The ThinkPad students on the other hand were more interested in being able to use computers in every class and were far more convinced that the technology will make learning and teaching better. This fundamental difference in attitude between the ThinkPad students and legacy students is also reflected in their patterns of computer use. The ThinkPad students used the Internet more and used the computer more for electronic mail with teachers. This difference in patterns of use is consistent with the differences in attitude as well. Overall, the ThinkPad students appear to be far more positively predisposed towards computers and thus approach computer enhanced pedagogy in a more positive way.

CONCLUSIONS

A key finding that emerge from this data is that longitudinal exposure to a computerized enriched learning environment might not necessarily change the attitudes toward computer enhanced learning unless the development of the computerized enriched environment is supplemented by the fact that every member in the environment is provided with the tools for connecting with the environment. This conclusion reaffirms a classical definition of the networked organization where it is assumed that every member of the networked organization has equal and democratic access to the network (Sproull and Kiesler, 1992). In this study, the legacy students are those who never felt the empowerment of access and so they continued to maintain either a negative attitude, or did not alter their attitudes in a positive way even when placed in a networked and computer enriched environment. On the other hand, the ThinkPad students entered the environment with a personal laptop computer and felt immediately connected to the environment. Indeed the academic atmosphere was getting increasingly designed and customized for the ThinkPad students and fitting in there was not a challenge to them.

Finally, this study addresses the question of effects of computer enrichment in teaching in a circumvented way. In stead of attempting to measure learning from traditional perspectives of grades and test scores, we have measured the way in which students perceive the changes brought forth in the learning environment with the introduction of computers. There is evidence in the data that the ThinkPad students considered the computer enriched environment to positively transform the learning space. The ThinkPad students also demonstrate that they are using the technology more for learning-related tasks. The legacy students, on the other hand, do not demonstrate these tendencies. Thus a positive attitude and increasing utilization of the tool by the ThinkPad students would suggest that the computer enrichment has a series of positive outcomes on the attitudes toward learning and the process of learning which in turn can have a positive outcome on learning itself. Some evidence for this claim is also found in the fact that the institutional research data indicate that the ThinkPad students of Year 1 and Year 2 have some of the highest grade point averages in several years and have the highest retention rate in several years. While it would be naïve to claim that computer enrichment is the "cause" for these trends, it would also be incorrect to discount the evidence about GPAs and not relate it to the process of computer enrichment. In many ways, the definitive answer about the effects on learning is still being debated, but the results here suggest that a networked institution where the students have easy access can foster a more positive attitude toward the use of technology in teaching and learning.

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The Design and Development of A Hypermedia-Supported Problem-Based Learning Environment

Min Liu
University of Texas at Austin
Department of Curriculum & Instruction
Austin, TX 78712
(512) - 471-5211
MLiu@mail.utexas.edu

Doug Williams
University of Texas at Austin
Department of Curriculum & Instruction
dcw@mail.utexas.edu

Susan Pedersen
University of Texas at Austin
Department of Curriculum & Instruction
Sped@mail.utexas.edu

Abstract: This presentation reports on an effort to create a hypermedia supported learning environment using problem-based learning for middle school students in the subject matter area of space science. The objectives of the program are to promote problem-solving skills, to facilitate learning of science through hypermedia supported cognitive tools, and to encourage collaborative learning. The paper discusses the design and development of the learning environment and cognitive tools provided. It also outlines a research agenda for conducting research studies using the environment.

Introduction

Enhancing students' higher order thinking skills has been a major challenge for educators. For years, educators have been trying to find ways to create learning environments that can encourage students to be active learners and develop problem-solving skills. The newly devised Texas Essential Knowledge and Skills, based upon the national educational standards, places more emphasis on the integration of different disciplines and knowledge. It states that "In Grade 6, the study of science includes conducting field and laboratory investigations using scientific methods, analyzing data, making informed decisions, and using tools... to collect, analyze, and record information. Students also use computers and information technology tools to support scientific investigations." This is a very important objective to achieve. However, little instructional materials are currently available to meet such a challenge.

The project to be presented is primarily concerned with these important educational issues and approaches them by investigating how to use hypermedia technology and problem-based learning to enhance higher order thinking skills for six graders. This is a research and development project in that the need for conducting it is based upon the current literature and research in education and instructional technology. Research has been an integral part of the development both as formative and summative evaluations. This presentation will focus on the design and development of the project.

Theoretical Assumptions

Educational literature indicates that problem-based learning is an effective way to meet the challenge of enhancing students' higher order skills. Problem-based learning (PBL) is an instructional approach that exemplifies authentic learning and emphasizes solving problems in rich contexts. Though originally developed in medical education, it has been subsequently applied to a wide variety of professional schools including business and law. Recently, there is a growing interest among educators in using PBL in the K-12 setting. In problem-based learning, students are given a problem replete with all the complexities typically found in real world situations, and work collaboratively to develop a solution. PBL provides students an opportunity to develop skills in problem definition and problem solving, to reflect on their own learning, and to develop a deep understanding of the content domain (Cognition and Technology Group at Vanderbilt, 1992; Lajoie, 1993; Jacobson & Spiro, 1995).

Three implementations of problem-based learning are of particular interest to this project. The anchored instruction by the Cognition and Technology Group at Vanderbilt used video-based scenarios to anchor instruction in authentic problem-solving tasks (Cognition and Technology Group at Vanderbilt, 1992). Schank's goal-based scenarios use computer simulations to embed learning in problem-solving activities (Schank, Fano, Jona, & Bell, 1993). Cognitive flexibility theory by Rand Spiro emphasizes learning from multiple perspectives in ill-structured domains (Spiro & Jehng, 1990). Though approached in different ways, all three implementations deal with solving complex problems in authentic situations, and emphasize the importance of learner-centered activities.

Educational literature has demonstrated the benefits of problem-based learning to enhance students' thinking skills (Boud & Feletti, 1991; Cognition and Technology Group at Vanderbilt, 1992; Stepien, Gallagher, & Workman, 1993). However, research has also shown that the implementation of PBL in the classroom is a challenging and complex task for both teachers and students. Learning in a PBL environment is a challenge to the students because it requires their active participation in a self-directed manner. The development of a solution plan requires learners to sift through vast amount of information, distinguishing that which is pertinent from that which is not. Learners need to be able to generate and evaluate their problem-solving goals, and organize their knowledge in ways that facilitate development of a solution. Teaching in PBL is also a challenge because teachers must not only be familiar with the PBL approach and the skills needed to teach with it, but also must be able to provide necessary and often "just-in-time" support tailored to individual and small group needs. Effective implementation of PBL requires necessary scaffolding (Koschmann, Kelson, Feltovich, & Barrows, 1996). This can be an overwhelming task in K-12 classrooms, where learners may have limited self-directed learning skills and classes may be large.

The purpose of this project is to create a hypermedia-supported problem-based learning environment for sixth-graders. Through research and development, it is our intention to investigate and understand in what ways the hypermedia technology can be used to share the responsibilities of the teachers to provide necessary and "just-in-time" scaffolding to support students' learning in PBL environments.

Program Description

Designed for six graders, the hypermedia program developed, Alien Rescue, utilizes video, audio, animation, text, and graphics to create simulations in which students will encounter problems in a rich context and engage in scientific inquiries. The simulation begins with the arrival in Earth orbit of a group of six species of aliens fleeing the destruction of their own planetary system. Their ship was damaged during their voyage, and except for their engines and computer databases, little of their technology continues to function. In order to survive, they must find new homes on worlds which can support them. Having picked up Earth broadcasts, the aliens learned our languages with the intention of asking for our help to relocate to worlds in our solar system. However, when their life support failed completely, the aliens could only complete a distress message to be sent once they reached Earth orbit, then entered a state of suspended animation, where they must remain until they are safely relocated to suitable worlds. This science fiction premise takes students to a newly operational international space station where they become part of a worldwide effort to rescue alien life forms.

Students are asked to take on the role of junior scientists working with experts aboard the space station to determine the most suitable relocation site for each alien species. To solve the problem, students must engage in a variety of activities. They must learn about the aliens and identify the basic needs of each species. They must then investigate the planets and moons of our solar system, searching them for possible matches with the needs of the aliens. Students gather this information by performing searches within a database on our solar system and launching probes that they have constructed to gather the additional information not available through the existing databases. They must also engage in collaborative planning and decision-making as they determine how to use the resources of the solar system effectively.

In the course of developing a solution plan, students learn about both our solar system, and the tools and procedures scientists use to gather that information. The hypermedia program allows students to have access to all the tools and information needed to develop a solution plan, but the program is structured in such a way as to not suggest what that solution should be. Students are encouraged to explore the virtual space station as they determine for themselves the information they need and the process they will use to develop a solution plan.

Design Features

The program incorporates design features that are supported by problem-based learning and hypermedia research. These features include: (1) situating the problem in a rich context and allowing learners to engage in scientific inquiries as experts do; (2) presenting the problem with its complexity, yet providing tools to support students in working with complexity; (3) providing information in multimedia formats to allow dynamic and interactive presentations that address different learning styles and student needs; (4) providing experts' guidance from multiple perspectives to facilitate knowledge acquisition and transfer; and (5) emphasizing the interrelated nature of knowledge through hypertextual nodes and links.

Specifically, The program provides a range of cognitive tools to scaffold students' problem-solving process. The tools are provided through the main environment of the program, the international space station, and through the imaginative goggles students are wearing wherever they go in the environment. The tools are in two categories: (1) information presentation and (2) knowledge construction (see Table 1). With the tools provided in the information presentation category, students are required to locate helpful resources, search and research existing knowledge databases, select relevant information, and make effective decisions. With the tools available in the knowledge construction category, students are to collect new data, interpret and organize data, build the rationale for their decisions and present their solution plan. Expert modeling and coaching for problem generation and problem solving is provided by expert demonstrating how to use the tools and stories illustrating how similar problems were solved by scientists. The scripts for such video clips were developed by examining how students used an earlier version of the program without modeling, noting their sources of difficulty, then providing modeling to support them.

Tool Category	Tool Name	Tool Function
Information Presentation	Conference Room	Students receive video messages from Earth in the conference room. These messages provide details about the problem situation and help to direct student activity. These messages help to maintain the impression that students are part of a scientific community, where coordinated efforts and frequent communication are essential components of problem solving.
	Alien Computer	Because the alien ship is damaged, scientists decide to move the alien computer to the space station. It contains information about the aliens: their physiology, technology, homeworlds, and history. However, early in the program students learn that the aliens had insufficient time to complete the translation of their computer database, so only a limited amount of information is available. Students must sift through the information to identify the needs of each alien species.
	Charts	A variety of charts are provided which are designed to scaffold students' efforts to organize their data and make decisions.
	Solar System Database	This contains information about our sun, the nine planets, and ten of the moons in our solar system. Information useful to solving the problem is provided, but the database is structured in such a way as not to suggest which pieces of information are relevant to the problem or what the best solution to the problem might be. The database includes pictures that students can bookmark for later retrieval.

	Messages	Periodically through the program, students receive video email. These messages are recorded in text form in the message tool for students to review as they deem necessary.
	Mission Database	Students can review information on five landmark probe missions to see how scientists designed probes to collect specific types of data in the past.
Knowledge Construction	Probe Builder	The Probe Builder contains lists and descriptions of real scientific equipment used in both past and future probe missions to investigate other worlds in our solar system. Students construct probes by making choices within four categories: probe type, communication, power source, and instruments. Budgetary constraints force students to consider their choices carefully and make compromises.
	Launch Room	Students review the probes they have built in the Probe Builder, and decide which ones to actually send in the Launch Room. Only probes that are launched show up in the Control Room, where data from them is displayed.
	Control Room	Raw data collected by the probes are displayed in the Control Room. Students must interpret this data in order to turn it into information that they can use to develop their solution. As in all probe missions, malfunctions are possible, and poor planning can result in mission failure.
	Notebook	Students use their notebook to collect and organize information useful in solving the problem. Students can create numerous sections within their notebook to help them organize their notes. The notebook was deliberately designed not to allow students to cut and paste information contained in the rest of the program, meaning that students must type their own notes based on what they think is important enough to record. A second function of the notebook is the bookmarks feature. Students can drag pictures and video from any part of the program to their notebook. These media elements are bookmarked for later review and possible use in presentations.
	Presentation Tool	A typical assignment for students to be given within *Alien Rescue* is to create a presentation on a decision they made and their rationale for that decision. The presentation tool permits students to create a series of slides using media they have bookmarked and notes from their notebook. Students choose from a number of slide templates, meaning that slides are fast and easy to make.

Table 1. Hypermedia-Supported Cognitive tools

Development

The development of the project follows a model based upon practice in the multimedia industry and current literature in instructional technology. This four-phase model has the following phases: (1) planning, (2) designing, (3) production and (4) evaluation (Liu, Jones, & Hemstreet, 1998). Testing and revision is an on-going process both from the teachers and the students. So far the production of this project has drawn expertise from various fields which include instructional design, hypermedia research, astronomy, graphic design, multimedia programming, video and audio, and writing. It is a collaborative effort by the Instructional Technology Program, the Institute for Technology and Learning, the Astronomy Department, and the McDonald Observatory at University of Texas - Austin.

Research Agenda

Both formative and summative evaluations are integral parts of the project. Two phases of formative evaluations have been conducted, one with a small group of sixth-graders for an informal evaluation, and one with a larger group for a formal evaluation. The purpose of these evaluations was to understand how the target audience reacted to the program and what improvements needed to be made. Based upon these evaluations, revisions have been made. The improvement of the program is an on-going process, however. In addition to program improvement, research is currently underway. Present and future research studies will investigate the research issues:

- the effect of the hypermedia-supported cognitive tools on students' achievement and their problem-solving skills,
- the relationship between the use of hypermedia-supported cognitive tools and students' achievement
- the possible differential effects of the project on students with different abilities,
- the effect of using expert stories on students' achievement,
- the change of students' epistemological beliefs as a result of using the program.

In this presentation, we will share the design and development of the project, demonstrate the program and outline the research agenda.

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Nano-Visualization On the Web

Laurie Luckenbill
Arizona State University
Center for Solid State Science, PO Box 871704
Tempe, AZ, USA 85287-1704
Laurie.Luckenbill@asu.edu

Kirsten Hintze
Arizona State University
Center for Solid State Science, PO Box 871704
Tempe, AZ, USA 85287-1704
khb@asu.edu

B.L. Ramakrishna
Arizona State University
Center for Solid State Science, PO Box 871704
Tempe, AZ, USA 85287-1704
BRamakrishna@asu.edu

Vincent Pizziconi
Arizona State University
Chemical, Bio and Materials Engineering Department, PO Box 876006
Tempe, AZ, USA 85287-6006
Vincent.Pizziconi@asu.edu

Abstract: The Interactive Nano-Visualization in Science and Engineering Education (IN-VSEE) project provides the first real-time interface for remote operation of Scanning Probe Microscopy (SPM) over the World Wide Web for educational and training purposes. In addition to providing "live remote control" of Nobel prize-winning microscopy techniques for doing discovery based learning of our material nanoworld, novel and highly interactive learning modules are being developed for diverse material systems which demonstrate the interdisciplinary nature of nanotechnology. IN-VSEE brings the excitement of research using cutting-edge technology to upper-level high school and first-year college students and teachers.

Introduction

Advances in science and technology have led to the design and manufacture of materials and devices of increasingly smaller dimensions. Engineering techniques have already surpassed the limits of resolution afforded by the naked eye. Since the 1960's device sizes have rapidly decreased from millimeter (10^{-3}) to micrometer (10^{-6}) and now approaching the nanometer (10^{-9}) scales. They may possibly decrease to atomic scale, measured in the angstrom (10^{-10})! Working at the nanometer scale has become a reality as scientists and engineers strive to exploit miniaturization techniques and technologies for the future. These nanotechnologies are envisioned to become the manufacturing reality in the next millenium. In an effort to introduce the fascinating nanoworld, Arizona State University has become a leader in the use of Scanning Probe Microscopes in research and education. The Interactive Nano-Visualization in Science and Engineering Education (IN-VSEE) project, led by ASU is a consortium of university, community college, and high school teachers, as well as industrial scientists and science museum educators. The IN-VSEE team has developed the first interface for remote operation of Scanning Probe Microscopy (SPM) over the World Wide Web (WWW) to promote education and training to prepare students for careers in the emerging nanotechnologies. The primary goals of IN-VSEE are to:

- convey the excitement of nanoscience and nanotechnology, promote student-initiated learning and increase interest in science and engineering careers
- teach fundamental concepts in science and engineering using visualization techniques to help students learn and integrate difficult concepts more effectively
- provide students with the capability to routinely explore materials in three dimensions with resolutions at the nanoscale and even down to the atomic scale
- demonstrate the feasibility of using the WWW for remote operation of sophisticated research-grade laboratory instrumentation that can be used directly in the classroom.

The IN-VSEE project is working to accomplish these goals by:

- creating a user-friendly interface for 'SPM Live!' remote SPM experimentation
- developing cross-discipline interactive instructional modules which provide key material science and engineering concepts
- providing an 'invitation' to explore the nanoworld via 'SPM Live!'
- highlighting the interdisciplinary nature of nanotechnology
- working with teachers to provide an introduction to the technology, as well as the use of this technology in teaching
- obtaining and cataloging exciting images of materials using the Nobel prize-winning SPM coupled with other advanced surface characterization instruments.

To date, IN-VSEE has succeeded in developing a WWW user friendly interface for remote control of a scanning probe microscope which is located on the Arizona State University Main campus. Additionally, 17 instructional modules are in the review phase of development. Three teacher workshops have been held and a two-day workshop is scheduled for August 1999. Accompanying the modules is a comprehensive image bank, accessible through the IN-VSEE Web site, of micrographs and nanographs created using various microscopies.

Remote SPM

The computer science task force of IN-VSEE has succeeded in creating a WWW interface to remotely control the scanning probe microscope from any on-line classroom in the world. Figure 1 shows the Remote operator interface page for SPM Live! From this page the remote operator can control the instrument, while others can

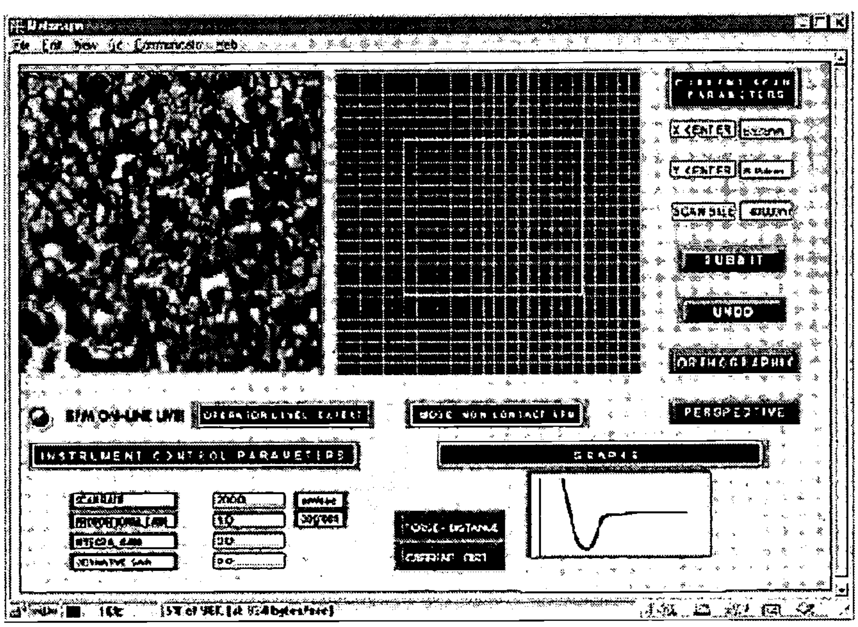

Figure 1: SPM Live! WWW Interface

participate in the same experiment using the observers' page. A chat-dialog box allows synchronous interaction between the operator, observers and IN-VSEE staff at the microscope site. Thus, students and scientists can discuss the image being viewed. Another window on the web page provides real-time video of the instrument and the IN-VSEE laboratory in order to personalize the viewing experience. The controller interface allows many of the same capabilities as the actual instrument, including zoom and rotation.

Instructional Modules

One specific aim of the educational modules is to provide a bridge between the 'virtual classroom' and laboratory. The modules provide a roadmap for students on how to design and conduct experiments, with the end goal of stimulating interest in remote operation of the SPM. The instructional modules center around a common theme of understanding and manipulation of natural and man-made materials. The module topics selected utilize interactive, discovery-based learning activities to introduce or reinforce applied material concepts within various disciplines and among various material classes over a wide range in scale. The interactive IN-VSEE modules provide:

- reinforcement and integration of key concepts and fundamental principles that are taught in high school and lower division college science, math and engineering curricula
- prospective users on the methodologies of experimental design and encouragement to formulate original experiments for remote SPM instrumentation on the web, through SPM Live!
- students with a flavor of research
- teachers with topics designed to meet national science education standards.

Figure 2: Connections made within each module. A material's atomic structure, properties, processing and performance are all related at the nano-level, as well as the macro-level.

The IN-VSEE instructional module task force has developed a module template to facilitate module development and provide consistency between modules. The module structure uses a discovery environment to provide background and relevance to the use of the SPM Live! remote instrument. Figure 2 represents the unifying concept reinforced in each module: that structure, properties, processing and performance of materials are intimately linked at all levels of scale. The standardized user interface and layout includes an attention grabber, and a navigation panel with a menu of topics and links. These topics and links include:

- real world applications
- FAQ's and trivia questions
- core material of text in images
- key concepts
- SPM relevant to the module, SPM Live!

The uniform structure of the modules facilitates ease-of-use between modules. The generic module template will also assist in development of future modules. Figure 3 shows a sample module interface.

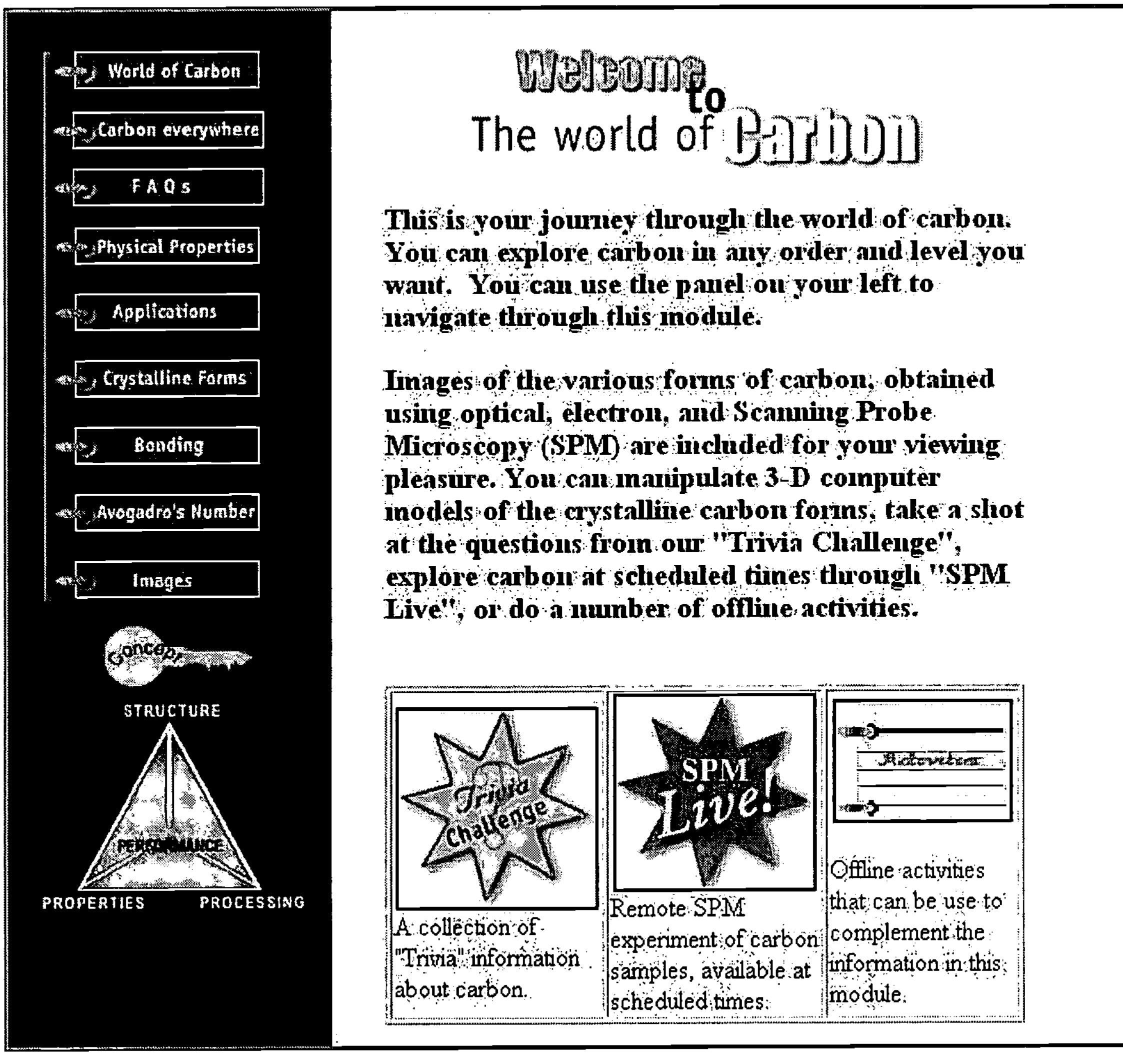

Figure 3: Instructional module interface. All modules use a standardized navigation system for consistency between the 17 modules.

Table 1 lists the titles of the 17 modules currently under development. The IN-VSEE team is beta testing modules in remote classroom demonstrations at Chandler-Gilbert Community College, Scottsdale Community College and Glendale Community College. Additionally, teachers will evaluate modules at the August workshop.

1. Making Sense of Size and Scale	10. Biominerals: It's a Hard Life
2. Theory and Virtual Operation of SPM	11. The Morphology and Use of Gold Films
3. The Allotropes of Carbon	12. What Is That in Your Dog's Dish?
4. The Five Kingdoms of Biology (Yeast)	13. Osmotic Pressure in Red Blood Cells and Plant Cells
5. Engineered Materials	14. The Miracle Molecule: DNA
6. Biological Structural Materials	15. The Music of Spheres
7. Why does a Light Bulb Burn Out?	16. Iridescence
8. Visualizing Properties: Friction	17. Modern Information Storage Media
9. The World of Liquid Crystals	

Table 1: Modules currently under development

Teachers' Workshops

The purpose of the teachers' workshops is twofold. First, teacher-training is provided to help teachers develop confidence in using this state-of-the-art technology. Second, discussions and brainstorming sessions with the IN-VSEE team are designed to assist teachers in exploring ways they can best use this technology to enhance their educational objectives. The first teachers' workshop in October 1997, focused on the use of image processing in the classroom. Image processing provides a dynamic, hands-on way to incorporate microscopy images in the classroom. (Greenberg et al. 1993) It also provides links to real world applications of microscopy. In this workshop teachers also provided feedback about the "Allotropes of Carbon" module. The second teachers' workshop in July 1998, focused on ways to overcome barriers to using remote SPM, instructional modules, and microscopy images in the classroom. The upcoming two-day teachers' workshop, scheduled for August 1999, will focus on hands-on activities and beta-testing of instructional modules, especially the "Making Sense of Size And Scale" and the "Theory and Virtual Operation of SPM" modules which are considered the keystone modules for providing background to students in understanding the nanoscale.

Image Bank

Also available on the IN-VSEE Web site is a database of more than 400 SPM and other related microscopy images. These are images collected by the IN-VSEE team during classroom demonstrations and experimentation, as well as images provided by other scientists at Arizona State University. The images come from a wide variety of microscopy techniques including Scanning Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Magnetic Force Microscopy, along with more traditional Optical Microscopy, and macroscopic photographs. Learning activities utilizing the images beyond the instructional modules are also being generated.

Conclusions

IN-VSEE has pioneered the effort creating a user friendly interface for remote operation of research-grade laboratory instruments i.e., the Scanning Probe Microscope for educational purposes. To provide a firm foundation for students and teachers about SPM experimentation, 17 instructional modules are being developed. These modules are currently being beta-tested. Additionally, a 'virtual' SPM is being developed for the web site to provide students practice using SPM equipment prior to doing their own experiments with SPM Live! Teacher workshops in the past and future, focus on providing teachers with training to use the technology to enhance instruction in their classroom. A database of images is available for downloading to use off line or for activities on-line. This project makes available state-of-the-art, Nobel prize-winning research tools available to students anywhere via the Internet. These powerful tools intrigue students in the process of scientific investigation and the exciting field of nanotechnology. IN-VSEE also provides resources which can expand cross-discipline curricula of any school on-line!

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Colt: A System for Developing Software that Supports Synchronous Collaborative Activities

Lauren J. Bricker[1], Marla J. Bennett[2], Emi Fujioka[3], Steven L. Tanimoto[4]
Department of Computer Science and Engineering
University of Washington, Box 352350
Seattle, Washington 98195-2350 USA

Abstract: This paper presents Colt, a system for the development of applications that support close collaboration between two or more users. The Colt system has three parts: a design methodology, a software toolkit, and additional tools for visualization and analysis. The software toolkit includes computational objects that support simultaneous manipulations from multiple users. We define and illustrate "Cooperatively Controlled Objects" (CCOs) and we discuss their design and development. Finally, a color matching activity is presented as an example of a collaborative activity that was built using Colt and CCOs.

Introduction

Developing applications to support synchronous collaboration by two or more users involves special challenges. An application designer needs to anticipate the interaction between the user and the computer as well as the interactions between the users. The designer also needs system support for development of software that accepts simultaneous input from multiple users on the same machine. The Colt system is designed to address both of these needs.

Colt is comprised of three parts, a design methodology, a software toolkit, and visualization and analysis tools. The design methodology is based on a series of questions to aid developers in the creative process of planning a collaborative activity. The toolkit supports the implementation of collaborative programs by providing a shell application, a hierarchy of "cooperatively controlled objects" (CCOs), and support for input from multiple users. CCOs are designed to support close collaboration among the users of a computer program. Each CCO contains a mechanism to record a history of how users cooperatively controlled the objects. The visualization and analysis tools present different views of the object histories. These tools can be employed after program testing to determine if the implementation meets the original design criteria. Colt is unique in its support for the development of co-present simultaneous computer based activities. Our motivation for developing Colt is described in detail in (Bricker98). Rather than cover all three parts of the Colt system, this paper describes only the software toolkit component.

The Cooperatively Controlled Object

Many common non-computer activities contain elements of highly synchronized cooperation. Some activities are done collaboratively purely for the social enjoyment. Some are done because they are easier to complete with additional help. Unfortunately, most desktop computers today are designed to accommodate input from one user at a time. Groups who wish to collaborate using one computer are forced to share control awkwardly through a single mouse and keyboard. Social and physical conflicts over these input devices may arise since current operating systems and application software only support a single input stream. One solution to the conflict problem is to provide a separate physical device for each user. Many video game systems, such as the Super Nintendo Entertainment System (SNES), do support multiple joysticks. However, the multi-user games for these systems often employ either a turn-taking mechanism, or simultaneous competitive play. The

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[1] Lauren Bricker is now with MathSoft, Inc., in Seattle, WA, with email at: `bricker@statsci.com`.
[2] Marla Bennett is presently with Tektronix, Inc., and she can be reached at `marla.j.bennett@Tek.com`.
[3] Emi Fujioka is currently with Stottler Henke Associates, Inc., Seattle, WA.
[4] Steven Tanimoto can be reached at `tanimoto@cs.washington.edu`.

risk in enforcing turn-taking is that inactive users will lose focus on the task. The risk in supporting simultaneous competitive play is that it does not appeal to many people, particularly young girls. Colt was developed to support simultaneous collaborative interactions in order to address these issues. One of the goals of this research is to define a class of interesting objects that helps to keep the users focused during collaborative activities.

Cooperatively Controlled Objects Defined

In object-oriented terminology, an object contains state and has behavior. A *controlled object* is an object containing methods that allow one or more users to manipulate properties of that object. Typically these properties are manipulated directly through input devices such as mice, joysticks, keyboards, etc. A *cooperatively controlled object* (CCO) is a controlled object that is designed to be manipulated simultaneously by more than one user based on certain relationships that hold between user inputs and components of the CCO.

Each CCO is assumed to have a set of components or "properties." Each property may take on one of a possibly infinite number of values. In the physical world some properties, like the location of a spot on the floor, may have an infinite number of possible values. We will assume that the computer representation is simplified with a finite set of discrete values.

A control mechanism for a CCO provides a means for a group of users to provide a value for one or for several (or even all) of the properties of the CCO. The control mechanism for a property in a CCO can be described as a function:

$$V = f((v_1, v_2, \ldots, v_n), (u_1, u_2, \ldots, u_m)),$$

where V is the output, or new value of the property, each v_i is the input value of the properties on which this function depends, and each u_j is the input-device state corresponding to the multiple users simultaneously manipulating the object. By providing functions for each of the CCO's modifiable properties, a complete control mechanism for the CCO can be specified.

Fine-grained sharing (FGS) is a previously studied approach for defining one class of CCO (Shen92). In FGS, an object is expressed in terms of its properties, each of which is controlled by one of the users. Although fine-grained sharing can offer users a clear delineation of responsibility and control for shared objects, it lacks the ability to compel tight cooperation among the users. Users who work on separate pieces of a "shared" document do not necessarily coordinate in real time. Instead the work is done asynchronously and are the users not forced to synchronize their activities to the same degree that one does in musical performance, dance, three-legged races, and the like. Our goal is to compel users to interact synchronously. CCOs support close collaboration though complex interactions with objects by adopting a more general framework than fine-grained sharing.

Specifying the types of interactions

Developers need to specify how closely the users in a collaborative activity should work together. In order to assist in the specification of the users' interactions, we have developed a sub-classification of synchronous activity based on how simultaneously the users interact with a screen object. An *asynchronous cooperative interaction* is one in which two or more users work independently on a task, then synchronize or coordinate their work by delivering information through messages such as conversation, snail mail or email. Participants of this type of cooperative interaction may not expect an immediate response from questions or requests. A *required asynchronous cooperative interaction* is one in which each user must complete their part of the activity before the other user may proceed. An example of this type of interaction in the real world is two people trying to go through a doorway that can only fit one person at a time.

A *synchronous cooperative interaction*, on the other hand, is one in which two or more users interact on the same task in real-time. Phone calls and text chat are examples of synchronous cooperative interactions. Often, the users in a text chat session take turns in writing (the reader will wait for the writer to complete a thought before responding), but they may also type at the same time. In this case a chat writer is not guaranteed that the other user(s) are focused on the current thread of conversation, but they are working *simultaneously*. A *required* simultaneous interaction is one in which the users must manipulate an object at the same time in order to make any progress on the activity. An example of this is two people attempting to lift a heavy piece of furniture, such as a piano. An *encouraged* simultaneous interaction is one in which the users do not have to manipulate objects at the same time, but doing so will allow them to complete the task more easily or in a shorter amount of time. Furthermore, their progress may be hampered (slower) if the interactions are not simultaneous. Moving a heavy object where no lifting is required is an example of this type of interaction.

User Interface Issues for CCOs

A number of interface issues must be taken into consideration when writing software to support two or more people working in a synchronous collaborative situation. If users are to manipulate a single object simultaneously, each user must have access to her or his own device to input their modifications. It is possible, if the users are co-located and using a single display, to use an off-the-shelf computer system with one mouse and one keyboard. However, this typically causes frustration because of either an unintuitive interface or a contention for the mouse or keyboard. Obvious solutions include having the users interact over a network, or to support multiple input devices on a single machine, similar to MultiIn (Bricker98).

Apart from the hardware, the software should indicate objects each user may access. Also, some indication should be given to all users as to which user currently has possession or is controlling each object in the shared space. Color usually affords a reasonable sign of object ownership, particularly if the color matches that of the owner's cursor.

The Colt Software Toolkit

There are many toolkits designed to support computer-based collaboration. These toolkits facilitate the development of cooperative software by providing abstractions for more difficult concepts in programming groupware applications, such as how to maintain synchronization of the objects or views of objects, and users dynamically joining and leaving sessions. Most of the existing toolkits, such as Rendevous (Hill93), GroupKit (Gutwin95), and Habanero (NCSA98) support synchronous cooperation over a network. There are also a number of collaborative systems that encourage communication at a distance through common objects (Gutwin95), tasks (Hill93) or physical situations (Bier91). Groupkit, in particular, uses indicators such as telepointers and other "awareness widgets" to indicate to others (working at distant locations) where a user is working on the screen. These systems permit cooperation, but the activities in which they are used do not require the users to work on a task simultaneously or to communicate frequently. Furthermore, none of these systems support co-present interactions..

Colt was designed to facilitate the rapid prototyping of applications in which users need to work simultaneously and interact frequently. Colt's toolkit includes the Collaborative Object-based Application Program Interface (CO-API) hierarchy of Cooperatively Controlled Objects and the ColImage application shell with support for various multiple-user input solutions. The overall architecture for the Colt system is show in Figure 1.

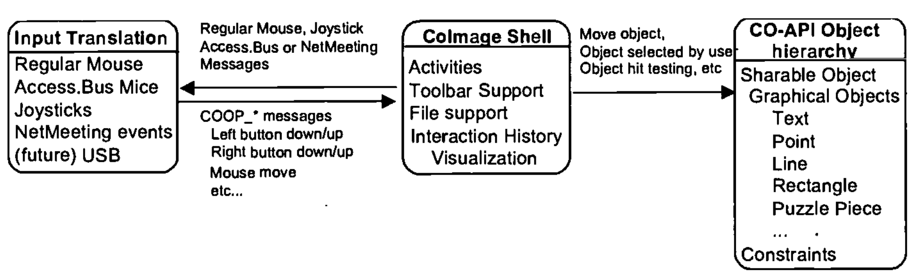

Figure 1. The Colt toolkit system architecture.

As input is delivered to the ColImage shell window, it is diverted to the Input Translation subsystem (ITS). This subsystem translates the input-device dependent event messages into input-device-independent Colt event messages. Colt messages include information about position, button state, and the user associated with the message. The activities implemented in the ColImage shell respond to the device-independent messages. The movement and location of each device is mapped to a separate color-coded cursor on the screen.

Based on the location and the owner of a cursor, the activity software can determine which objects to manipulate and if that user may manipulate that object, respectively. In particular, if a user attempts to manipulate an object he does not own the object will not allow that user to control the object, and the attempt to control the object is ignored. The CCOs in the CO-API do not respond directly to the input events, they only respond to changes to object properties.

The CO-API

The CO-API is comprised of a number parts: a hierarchy of cooperatively controlled objects (including object necessary for specifying access and recording a history of events) event, a constraint system, and tools for viewing and transforming bitmapped images.

Cooperatively controlled objects are implemented in our software environment as reusable C++ classes, and they thereby can inherit state and behavior. CCOs derive the ability for sharing from access control lists similar to (Shen92). Other properties of a CCO include location, size, orientation, coordinate system, display parameters, and color. An object will ignore attempts to change a property by users who do not have the proper privileges (as dictated by access control lists). In order to track when the users cooperatively control objects, each object in the CO-API can also store information regarding the users' changes to an object, or *actions*, in what we call a *history of actions*. The information stored for each action will vary depending on how the object is manipulated, but typically includes the changed property and the new value, which user effected the change, when the change occurred and how long it took. The history of actions may be saved and analyzed after the activity is completed. This information may be restored at a later time for evaluation purposes. The interface for an activity can be designed to include visualizations that aid the analysis of measured quantities such as the number of interactions on an object, the total time of each interaction, how the interactions overlapped, or the order in which the users interacted.

In addition to the object hierarchy, the Colt system includes a *Constraint Manager* that keeps a list of constraints currently used in the Colt system. Each constraint contains a list of input objects, or objects that may affect other objects in the system, and a list of output objects, or objects which are affected by changes to other objects. At this time, only one-way functional constraints are handled.

The CoImage Shell

We support development of collaborative activities using CCOs by providing an application shell that handles the operations, such as handling input from toolbars, and saving and restoring files, which are shared by all activities built in the environment.

As in (Bricker95), the activities supported by Colt allow each user to own an input device and corresponding colored cursor on the screen. The color of the cursor identifies its user. Objects are displayed in a user's color if only they are permitted to manipulate that object. For example, a tool on the toolbar is outlined with the user's color if they are permitted to use that tool. If two users may select a tool, it is outlined with both of the users' colors. The design and implementation of an activity defines how the tools in the toolbar are used. Some tools simply set the value of a property for an object, while others may change a mode for the whole activity. Depending on the design of the activity, a user's cursor may change shape to indicate that a user just selected an instance of a particular tool.

The CoImage shell also supports saving and restoring data in a number of formats. The shell includes methods that save the state of an activity as a binary data file so that a user can continue at a later date. The shell also includes separate methods for saving a history file in a tab delimited text format. This format permits an experimenter to visually read the data or analyze it using another program such as a spreadsheet. A copy of the data is also written in a binary CoImage data file format whenever the text version is written to disk. The CoImage shell can also save image data in the standard Microsoft Windows bitmap format, and in a format that can be read by a World Wide Web (WWW) browser.

The CoImage shell also includes methods that read and write a text-based problem description file. A problem description includes an initial state, goal states or criterion the users are expected to reach, any constraints enforced on the users in reaching that goal, and a possible scoring criteria. The current implementation of the shell contains methods that can be overridden by an activity developer to read and write problem description files. Most activities implemented with Colt to date support a problem file that contains the number of users, the initial state of the program, a text description of the goal state(s) that can be presented to the user, and the scoring criterion.

The Input Translation Subsystem

The input translation subsystem (ITS) was developed to abstract away the details of any specific input device. Device dependent input events delivered to the ColImage shell are diverted to the ITS, where they are translated into input-device independent messages. These Colt messages include information about the mouse position, the state of the mouse buttons, and the user associated with the message. Thus, the application developer only needs to respond to the one set of messages.

The system requirements for the toolkit are Pentium based PC platforms running Microsoft Windows 3.1 or Windows 95. For the co-present, single display situation, we currently support the Access.Bus multiple input system from Computer Access Technology Corporation for Windows 3.1 and Microsoft Sidewinder™ Game Pads for Windows 95. The ColImage Shell supports distance collaboration with Microsoft NetMeeting™ conferencing technology. NetMeeting supports audio, video, file and data transfer, as well as a rudimentary sharing (turn-taking) mechanism for single-user applications that are not designed to be manipulated simultaneously.

Activities that employ cooperative control

We have developed a number of activities that employ CCOs using the Colt system that include a Collaborative "Drawing" Activity, based on the Etch-a-Sketch toy developed by Ohio Arts, a collaborative puzzle activity, a coordination game based on a game where two people each use a chopstick to pick up a "bean," and a color matching activity. These first three of these activities are described in detail in (Baker97 and Bricker98).

The Color Matcher activity, as described in (Bricker95), was originally implemented in Microsoft's Visual Basic with the MultiIn system to support the Access.Bus multiple input devices. MultiIn can only be used under Windows 3.1, and we wished to conduct a user study on a version of this activity under Windows 95 (for more information on the user study, see (Bricker98)). The original version of the Color Matcher activity took an undergraduate student approximately ten weeks to implement. The re-implementation of the activity using Colt took the author only a few days. This version included an interface that mirrored the original version as well as a new CCO method for selecting the users' color, shown in Figure 2. In this activity, the users' color is set according to the color of a selected pixel in a bitmapped image (e.g., a palette). The pixel location is set by the location of the centroid of a triangle. Each user controls the vertex of the triangle that is colored to correspond to the color of their cursor. Although it would be impractical to have a bitmapped image of a full 24 bit color palette, the Windows 256 color palette affords a reasonable approximation for the purposes of the activity. The users' color in the Colt/CCO version of the activity is scored in the same way as the original application – based on the distance from the target color in RGB color space.

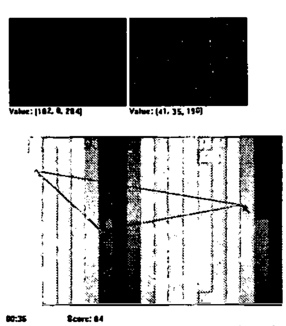

Figure 2. The Color Matcher activity user interface.

Conclusions and Future Work

We have presented the toolkit part of the Colt System, as well as a collaborative activity that was built using it. The software toolkit includes Cooperatively Controlled Objects, which generalize fine-grained shared objects in being manipulated by more complicated, higher degree-of-freedom methods. .

The Colt system was tested in the development of the drawing, jigsaw, and chopstick activities. Further testing needs to be done with developers to improve the system. There are many enhancements we'd like to add to the software toolkit, including adding support for other types of multiple input devices, such as via the Universal Serial Bus, and support for multi-way constraints. The CCOs designed to date can also be ported to other platforms, such as Java, support distance collaboration in WWW based activities. We also wish to continue to expand the CCOs in CO-API to support other types of collaborative interactions and activities. Colt could be used to implement collaborative versions of popular games such as: Tetris™, where one person controls side-to-side motion while the other controls rotation. Additionally, CCOs could be used in 3D virtual worlds, or first-person perspective games such as Doom™. An example of a CCO in such a game is a cooperatively controlled latch on a door where users may be required, encouraged, discouraged or forbidden from manipulating the latch at the same time.

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Knowledge Organizations Resulting from Pairs' Problem-Solving Versus Information Gathering Activities

Jeanne Weidner*

Michael Ranney*

Marian Diamond**

*Graduate School of Education, E-mails: jweidner@socrates.berkeley.edu, ranney@soe.berkeley.edu
** Integrative Biology, E-mail:diamond@socrates.berkeley.edu
University of California at Berkeley, 94720, USA

Abstract: We examined the externalized knowledge structures elicited from subjects who used the multimedia program *BrainStorm: An Interactive Neuroanatomy Atlas* under two contexts. In the problem-solving context, student pairs were asked to solve a clinical case resulting from cranial nerve injury. In the second, information-gathering context, student pairs were given traditional questions to answer about these cranial nerves. We assessed student knowledge using individual pre- and post-tests, and concept-based Pathfinder Networks (PFNETS), and surveyed students' opinions of the contexts. Although the survey seemed to indicate a preference for the problem-based context, the preference was not universal, and only marginally significant. The information gathering context yielded higher gain scores, and generated PFNETS more similar to the instructors' relative to the results from the problem-solving context. In addition, students who were in pairs with at least one graduate student were more likely to yield higher post-test scores and PFNETS that resembled the instructors' networks.

The Role of Technology for Problem-Based Learning

Computer technology may prove to be an important ally in support of PBL, and may help to alleviate several of the shortcomings associated with it. By providing an authoritative source that is readily available (theoretically) at any time, it allows an instructor to provide more one-on-one attention to those students who require it, thus potentially lowering the cost of the time-intensive aspects of PBL. It may also be used to alleviate the occasional problems regarding structured feedback that are sometimes associated with PBL; this readily available source of information might reduce the frustration that some students feel when trying to solve problems in a PBL environment. In addition, computer programs, to varying degrees, can be used independently or collaboratively, both in and out of classrooms. Both Linn (1992) and Okada and Simon (1997) recommend the use of student pairs as an effective alternative to group learning that incorporates the advantages of group learning, while minimizing its disadvantages. The latter reported that pairs of subjects were more successful than individuals while interacting with a computer simulated genetics laboratory during a discovery activity. White and Frederiksen (1998) report that collaborating with a higher-achieving partner while engaging in reflective activities may significantly improve the performance of lower achieving students. Just this type of effective combination can occur in heterogenous pairs of students engaged in problem based learning.

Very few, if any, studies have investigated how multimedia use in a problem-based format may differ from its use in the service of more traditional school tasks--such as information gathering--with regard to measures of problem solving ability, domain knowledge, and knowledge organization, etc. The paucity of research in this area, in part, motivated the present study.

The Utility of Pathfinder Associative Networks

One of the characteristics of PBL that accounts for the advantages attributed to it may be the way resultant knowledge is organized (Norman & Schmidt, 1992). This conjecture has support from Durso, Rea, and Dayton (1994), who used Pathfinder Associative Networks ("PFNETS"; Schvaneveldt, 1990) to measure the knowledge organizations of subjects solving an insight problem, relative to those who were given the information as a story (rather than as a problem to solve). Pathfinder networks reflect general conceptual proximities that are empirically derived from subjects' ratings of the relatedness of pairs of terms. Each network representation (PFNET) yields a "concept map" of a subject's knowledge organization (e.g., Figure 1). Durso, et al. (1994) report that people who solved an insight problem had a significantly different knowledge organization, as measured by PFNETS, than did those who (a) did not solve it or (b) were presented with the information in a non-problem format.

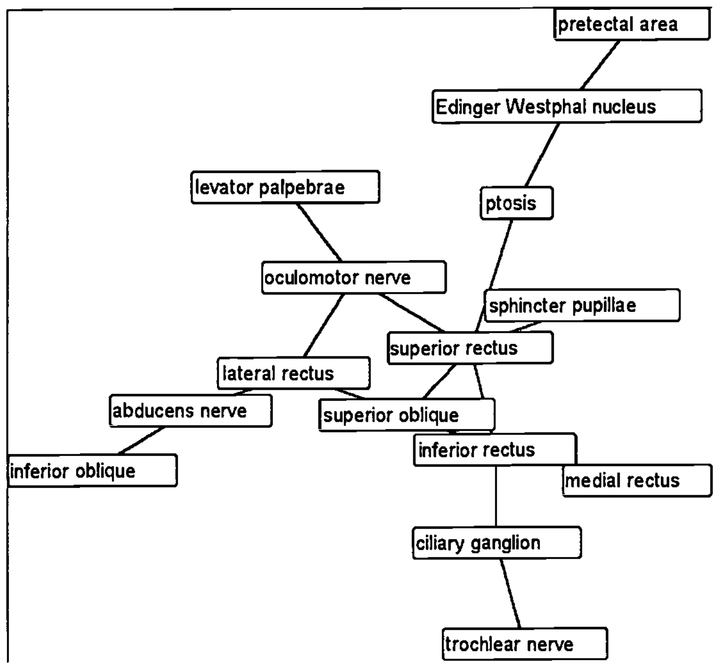

Figure 1. A student's PFNET for Exercise 1.

Additionally, Goldsmith and Johnson (1990) used PFNETS to assess the knowledge structures of students over the course of learning in a conventional statistics classroom–and to compare the students' structures with those of the instructors, over time. They found that the knowledge representations as generated by Pathfinder offered a useful assessment of classroom learning and that the correlation between a student's structure and an instructor's was a good index of how much the student learned about the domain of study.

Results

Pre- and Post-Tests

Paired sample t-tests revealed significant score differences between the set of corresponding pre-test and post-test items for all combinations of exercises and context (*p's* $< .005$, see Table 1). The difference in the means on the (full) post-tests between the two exercises indicates Exercise 2 was more difficult, in terms of proportion correct (Exercise 1 = .74; Exercise 2 =.54; $p< .001$), but the context in which students learned the material had no effect on these post-test scores (PS=.62; IG = .66). However, the information gathering context yielded higher gain scores than the problem solving context when both exercises are combined (PS gain = .15; IG gain = .23; $p=.06$; marginally significant). Additionally, analyses of the post-test item scores by type of question (recall, analysis, or integration) or topic (anatomy, function, or symptoms) revealed no significant context-based differences in score.

Exercise	Context	Pre-Test Mean	Post-Test Items Mean	Mean Difference Gain	SD	Paired T-test	*p* value
1	PS	0.68	0.83	0.15	0.13	3.854	.003
	IG	0.67	0.89	0.22	0.12	6.000	.000
2	PS	0.41	0.57	0.16	0.16	4.528	.001
	IG	0.42	0.67	0.25	0.25	4.672	.001
Overall		0.55	0.74	0.19	0.14	9.048	.000

Table 1. Corresponding Pre-Test versus Post-Test Item Performance by Problem Solving (PS) and Information Gathering (IG) Contexts, as well as by Exercise.

Exercise	PFNET	PS Mean	IG Mean	F	Significance
1	Instructor 1	.4521	.4629	0.038	.847
	Instructor 2	.4765	.6461	3.106	.094
	Instructor 3	.3624	.5029	5.053	.037
	Instructor 4	.4777*	.4775	0.000	.997
	Instructor 5	.4533	.6108	4.189	.055
2	Instructor 1	.4375	.4863	0.588	.452
	Instructor 2	.4238*	.3976	0.464	.504
	Instructor 3	.4219	.4707	0.688	.416
	Instructor 4	.4520	.5072	0.877	.360
	Instructor 5	.4181	.4684	0.667	.424
Wilcoxon Signed Rank Test		*1 higher/1 tie	8 higher	Z=-2.395	.017

Table 2. Correlations of Student and Instructor PFNETS by Problem Solving and Information Gathering Contexts

Pathfinder Networks

Student pathfinder networks (PFNETS) were compared to instructors' PFNETS on both individual-instructor and a combined-instructor (averaged) bases. A significant difference among the correlations and instructional contexts was found for Exercise 1 regarding the major instructor for the course (Instructor 3 in Table 2). In this case, students who learned the material in the information gathering context produced PFNETS that yielded higher correlations with that instructor's PFNET than those learning in the problem solving context (.50 vs. .36; $p<.005$). Two additional experts (Instructors 2 and 4 in Table 2) yielded a marginally significant result for Exercise 1 ($p=.094$ *and* $.055$). More generally, a Wilcoxon Signed Ranks Test showed that overall, the information gathering PFNETS correlated more highly with instructor PFNETS than did the problem-solving PFNETS (Z= -2.395; $p=.017$). Comparisons among the instructors' PFNETS revealed significant correlations for every comparison (*r's* ranging from .40 to .93; $p<0.01$). In addition, we observed a significant meta-correlation between students' post-test scores and their PFNET correlations with the instructors. For both exercises, students who scored higher on the post-test had generally significantly higher PFNET correlations with the instructors' PFNETS (*meta-r's* ranged from .33 to .85; see Table 3).

Exercise	Instructor	1	2	3	4	5	Combined
1	Post-Test	.77*	.59*	.83*	.68*	.85*	.83*
2	Post-Test	.61*	.33	.50*	.54*	.58*	.55*

Table 3. Pearson (Meta-)Correlations of Post-test Performance with Student/Instructor PFNETS Correlations (*significant at the .001 level; 1-tailed).

Pair Composition

Across both exercises, pair composition had significant effects on student performance, both on the post-test score proportions and on student/instructor PFNET correlations (see Table 4). Although there were no differences in the pre-test scores of undergraduates based on pair membership, those who were paired with graduate students performed better on the outcome measures (i.e., both gain-scores and PFNET correlations) than their counterparts who were paired with fellow undergraduates (see Table 5). In fact, graduate students in mixed pairs also benefitted more from the mixing when comparing their PFNET correlations with the instructors' relative to those in graduate-graduate pairs (r=.60 vs .50; $p < .05$).

Exercise	Measure	Undergrads	Grads	Mixed	F	Significance
1	Post-Test Score	.64	.76	.79	4.850	.020
	PFNETS Correlation	.32	.54	.60	13.634	.000
2	Post-Test Score	.44	.59	.58	3.988	.036
	PFNET Correlation	.34	.49	.45	5.737	.011
Overall	Post-Test Score	.54	.68	.69	4.526	.017
	PFNET Correlation	.32	.49	.57	18.002	.000

Table 4. Differences in Pair Performances based on Composition. "Score" indicates mean proportion of correct answers, and "Correlation" indicates comparison with experts' combined PFNETS.

	Measure	Homogenous Pairs	Mixed Pairs	F	Significance
Undergrads	Pre-Test Score	.48	.49	.002	.969
	Gain-Score	.14	.30	4.742	.045
	PFNET Correlation	.33	.53	16.402	.001
Graduates	Pre-Test Score	.59	.59	.003	.956
	Gain-Score	.19	.20	.044	.836
	PFNET Correlation	.50	.60	4.437	.046

Table 5. Graduate and Undergraduate Performance Based on Pair Membership. "Score" indicates mean proportion of correct answers, and "Correlation" indicates comparison with experts' combined PFNETS.

Survey/Questionnaire

On the questionnaire that elicited student opinions about the relative merits of each of the tasks, students agreed that both methods (1) helped in comprehending and remembering the material, (2) allowed for success in accomplishing the task, and (3) should be incorporated as regular course activities. Fourteen of the 26 items yielded statistically significant findings. Students were more likely to agree that problem-solving, rather than information gathering, a) contributed to the integration of the material, b) promoted reflection, c) provided insight into applications, d) supported collaboration, e) required the use of prior knowledge, f) piqued curiosity, g) encouraged deep understanding, h) provided contextual meaning, i) helped to better understand the lab, j) prompted additional questions, k) provided relevance, and l) was a meaningful activity (all p's $< .05$). Conversely, students were more likely to agree that information gathering, rather than problem-solving encouraged both rote memorization and attention to detail (p's $< .05$). However, while students seemed to prefer, in general, the problem-solving method, this finding was only marginally significant on a five point scale (in which 5= "strongly agree" and 1= "strongly disagree": PS mean =3.55, IG mean=2.77; $p=.108$).

With regard to their opinions about the multimedia program, 63% of students disagreed or strongly disagreed–while only one student agreed–with the statement, "Learning this material could have just as easily been done by using a textbook." Indeed, 82% agreed or strongly agreed (with no one in disagreement) with the statement, "The program provided support that would be difficult to obtain through other methods."

On the survey questions that elicited their attitudes about working on each of the tasks, students were more likely to agree that they enjoyed the problem assignment (relative to the IG assignment), and were interested, motivated, and involved in the problem. Still, although 79% of respondents disagreed or strongly disagreed with the statement, "The questions were too difficult to answer using the program," significantly fewer (59%) disagreed that "the problem was too difficult to answer using the program" (5 point scale: IG = 2.23, PS = 2.59, $t= -2.16$, $p < .05$). The opinion that the problem was too difficult to solve was modulated by the particular exercise; students who received the problem as their second exercise were more likely to view it as difficult (E1=2.4 vs E2=3.0;

p=.024). Students overwhelmingly agreed or strongly agreed that solving case problems encourages the integration of concepts (96%), whereas only 27% agreed that answering direct questions does so ($t=4.271$, $p<.001$).

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The Crucial Roles of the Instructional Designer and the Subject Matter Expert in Multimedia Design

Mike Keppell
Biomedical Multimedia Unit, Faculty of Medicine, Dentistry and Health Sciences
The University of Melbourne
Australia
m.keppell@medicine.unimelb.edu.au

Abstract: This paper examines a study which developed and began testing a process to assist instructional designers in eliciting unfamiliar content from subject matter experts and in conceptualizing that content. It explored the development, trial, training and application of the "Content Production Process" (CPP). Three major insights were gained into the use of the CPP. Firstly, the novice instructional designer found that knowledge map construction was useful for assisting him to think carefully about the unfamiliar content. Secondly, the knowledge map appears to have been a useful "communication prop" for assisting the instructional designer in interacting with the subject matter experts. Thirdly, the instructional designer found that combining a "teachback" procedure with the knowledge map provided a powerful means of checking his understanding of the content against that of the expert. The CPP offers a process for improving the interviewing process in multimedia instructional design.

Nature of the Problem

Imagine attempting to design an instructional unit in an area in which you have no understanding or expertise. How would you approach the unfamiliar materials? What are your choices? You can read textbooks or reference materials or you could talk to experts in the area. Subject matter experts, however, are often busy people. How can you optimize your time spent with the subject matter expert? How can you elicit a sufficient quantity and quality of information so that instructional design is possible? What questions would you ask of the subject matter expert? This paper addresses the relationship between the instructional designer and subject matter expert and examines more particularly a possible method for eliciting and conceptualizing unfamiliar content knowledge from the subject matter expert so that efficient and effective instructional design can proceed.

Research on instructional design has not adequately addressed the conceptualization by the instructional designer of unfamiliar content as presented by a subject matter expert. Many researchers in the field of instructional design acknowledge the importance of this conceptualization (Brien & Towle, 1977; Bratton, 1981, 1983; Cram, 1981; Wallington, 1981; Rutt, 1985; Armstrong & Sherman, 1988; Morrison, 1988a; Tessmer, 1988a, 1988b; Rodriguez, Stephens & Arena, 1991; Davidove, 1993; Maple, 1994; Lee, 1994; Ingram, Heitz, Reid, Walsh & Wells, 1994; Yancey, 1996); however, only general heuristics and suggestions have been offered. There appears to have been no systematic efforts to develop a comprehensive strategy for the conceptualization and elicitation of subject matter knowledge.

This crucial skill of an instructional designer is a potential "bottleneck" for the development of instructional materials in project-based multimedia environments. For example, an instructional designer may be required to design multimedia in content areas as diverse as mining, engineering, taxation, alumina processing, beef production and medicine. It is not possible to be conversant in all of these diverse content areas, and the instructional designer must rely on subject matter experts to assist with this content. Without an effective strategy for interacting with the subject matter expert, valuable time will be lost understanding and organizing the content, hence the need for an efficient and effective method to assist in the instructional designer–subject matter expert interaction (Keppell, 1997).

Instructional Designers and Subject Matter Experts

Instructional Designer

Instructional designers tend to be process-oriented individuals as they can apply instructional design principles to a wide range of content areas. The designer usually begins by analyzing goals, needs and learner characteristics in an attempt to understand the instructional problem. The scope and content of the subject are then identified. These areas represent the "problem space" of the instructional designer. One of the designer's main jobs is to select, sequence, synthesize and summarize the content for instructional purposes and deliver the desired product. "Despite having *no content expertise,* the designer has a set of representations based on a *"design model"* which can guide the development of an effective training program" (Nelson, Magliano & Sherman, 1988, p. 32) (italics added).

The *design model* is the designer's accumulated knowledge of how instruction should be developed. It is the amalgamation of general experience, educational background and instructional experience. The design model is analogous to a script. Scripts are knowledge packages in memory which allow individuals to understand routine activities (e.g. eating in restaurants, visiting the dentist). They are prototypical or stereotypical information useful in everyday occurrences. Schank and Abelson (1977) suggest that we have hundreds of stereotypical situations coded in memory, each having idiosyncratic variations. The designer has a generic script which can be applied with variations to new instructional problems. This design model is one of the most important characteristics required by the designer in approaching a new instructional problem. The advantage of the generalized script is that it is adaptable to new instructional problems. The concept of the script suggests how a designer can approach unfamiliar content. The aim of the designer in the interaction with the subject matter expert will be to "formulate a working content structure within which the information and skills to be taught can be formed into a sequence and hierarchy" or other appropriate structure (Wallington, 1981, p. 30).

Subject Matter Expert

As the name suggests the subject matter expert (SME) or the content expert is an authority on a particular domain of knowledge from whom the designer is attempting to elicit knowledge. The SME may be the client in the business, academic or military setting. Nelson, Magliano and Sherman (1988) suggest that "experts'" knowledge structures are more highly organized and well integrated" (p. 30) than those of novices. "Experts tend to "chunk" or organize information into more highly structured patterns and to complete the task more quickly than novices. Experts also appear to represent problems differently than novices because of their superior ability to recognize patterns, infer relationships, disregard irrelevant information, and recall similar problems from past experience" (Nelson, Magliano & Sherman, 1988, p. 33). One of the SME's functions in training is to provide accurate content to the design team. In this study SME's have two roles: (1) providing a clear description and explanation of the content area being examined, and (2) assisting the designer's conceptualization by clarifying and verifying the content.

Phases of the Study

Phase 1: Development of the Process

The CPP was developed by using an eclectic approach. Ausubel's concept of "intellectual scaffolding" forms an important part of the CPP (Ausubel, 1960, 1963, 1968). When instructional designers are working with SME's their aim is to create a conceptual scaffold and then attach content elicited in the subsequent interactions with the SME. As designers create this conceptual scaffold (knowledge map) and elaborate the content they begin to conceptualize the relationships within the content. It seemed that some form of graphic organizer might be an appropriate tool for representing successive iterations of the instructional designer's attempts to conceptualize unfamiliar content, and of the various forms available the knowledge map was selected (Breuker, 1984; Dansereau, 1991a, 1991b). In addition to helping the instructional designer conceptualize unfamiliar content (Wedman, 1987), it was thought that there would emerge a second advantage of making the instructional designer's perceptions public for the subject matter expert to examine.

Phase 2: Personal Trial of the CPP

The personal trial of the CPP helped to crystallize the researcher's conceptualization of the process. Initially, it was necessary to keep pace with the SME and attempt to obtain an overview of the content area. A second phase began with the SME viewing the map and understanding the role of the instructional designer within the interaction. At this point in the interaction the SME appeared to become more cooperative and provided more detailed explanations because a certain rapport had been developed. A third phase involved both the designer and SME collaborating to achieve the goals of the interaction. The fourth phase centered on cultural understanding with the instructional designer feeling more effective in conceptualizing the content when the content could be viewed from the SME's point of view. After the trial an effort was made to formalize the process to allow it to be taught to another instructional designer.

Phase 3: Training a Novice Designer to Use the CPP

The training program addressed both the declarative and procedural knowledge required by a novice designer when working with SME's in a "real" setting. The novice designer was trained for a total of thirty-three hours in all aspects of the CPP. Personally teaching the process to John provided the researcher with the opportunity to observe the process in action and document the proceedings. John achieved competency in all aspects of the CPP as it was conceived at that point and was ready to work with SME's in a real setting. He had shown competence in both declarative and procedural knowledge in relation to the CPP.

Phase 4: Case Stories

These case stories investigated the designer–SME interaction within the real-world context of a military setting. They attempted to focus on discovery, insight and understanding from the perspectives of the designer and the SME's being studied. In this way they attempted to "illustrate conclusions to which the author ... was ... already committed" (Biddle & Anderson, 1986, p. 238). Such case stories are intended to provide new insights and understandings and "... not provide conclusions, however, that reflect evidence" (p. 238).

This case focussed on how one instructional designer aided by the CPP interacted with, elicited and conceptualized unfamiliar content. Through the process of the case it was possible to examine the situation in depth, detail and from a holistic perspective. This portrayal provided a solid basis for examining what took place in the interaction. The following important areas emerged during the case: (1) Strategies for conceptualizing the content, (2) the knowledge map as a communication prop, (3) the teachback function and the knowledge map.

Strategies for Conceptualizing the Content

Throughout the five interviews in the case John appeared to become more adaptable and flexible in his interactions with the SME's. As the interviews progressed, John's ability to react to the situation was more noticeable. He appeared more comfortable with clarifying the content when he was unsure of its meaning. In his initial interactions, John often allowed Steve (first SME) to complete a lengthy explanation before he sought clarification. In later interviews with Bob (second SME), John was able to seek more regular explanations. As John became more conversant and more confident with the interaction his questioning also became more specific.

John's preferred approach to gaining an initial understanding of the content was to obtain an overview of the area. He appeared to need to see the conceptual terrain of the content area before examining the area in more depth. This was consistent with the author's own application of the CPP. John commented that he needed to do this so that he could see the extent of the information that needed to be covered. It may represent a heuristic that designers need to use in the process of interacting with SME's.

John also found that the knowledge map was a useful tool which assisted him when wrestling with unfamiliar content and displaying the content to the SME. John suggested that the construction of the knowledge map "forced me to think about what was said" and "focuses my thinking". The use of the knowledge map appeared to assist John in thinking more carefully about the content. Holley and Dansereau (1984, p. 8) suggest that the creation of a knowledge map may force the constructor to process the content in "greater semantic depth". Furthermore, Holley and Dansereau also suggest that reorganizing the information in the form of a knowledge map may activate both the spatial and verbal processing systems, allowing the developer to gain a deeper understanding of the information.

The Knowledge Map as a Communication Prop

The use of the knowledge map in the designer–SME interview may act as a communication "prop" to improve the interpersonal nature of the interview. The interaction with the SME can sometimes be a stressful experience which may be lessened by the use of a visual prop in the form of the knowledge map. The knowledge map appeared to assist John in handling the sometimes difficult interpersonal aspects of the interview. "And it really helps me, because when you're dealing with someone who you don't really know very well ... I'm nervous ... and rather than sort of concentrating and talking to him and looking at him in the eye, I could focus attention on the map".

The knowledge map may also help to focus the attention of the SME and designer on the most important parts of the content. Accurate content on the map may not require further attention. It may not be necessary to further explore this information because the SME has verified the accuracy of the content. John used the map in this sense by check-marking accurate information on the map as it was examined by the SME. In this sense the map may act as a communication device that confirms the knowledge shared by the designer and SME. The focus of the interview can then be concerned with the areas that are most in need of attention.

The knowledge map appeared to assist both the SME and designer in recognizing *gaps* in the flow of the sequence and in the information; for example, Steve instantly recognized the absence of safety procedures in the map John had created on the C7 rifle. Likewise, once John had created the map on landmines, he himself, was able to pinpoint gaps in the information that he addressed in the subsequent iteration. McAleese (1988), in the context of developing expert systems, suggests that experts were able to recognize and pinpoint inconsistencies on a concept map.

Lambiotte, Dansereau, Cross and Reynolds (1989, p. 332) suggest that knowledge maps are "computationally efficient" in that they "facilitate faster search and recognition of relevant information" (p. 332). Efficiency is defined in terms of how the knowledge map representation assists attention focusing, knowledge assimilation and knowledge searching of new information. The presentation of the knowledge map to the SME may activate both the spatial and verbal systems thus increasing the processing efficiency of the information.

The Teachback Function and the Knowledge Map

In the initial conception of the CPP it was envisaged that the designer would stop at certain points throughout the interaction and teach the material back to the SME. This proved far too ambitious for a designer who is totally unfamiliar with a content area. It was not possible for the designer to gain sufficient familiarity with the content to teach back the material to the SME. John also felt uncomfortable with this practice. "I still think the toughest nut to crack for me is the teachback, I could just go over it and kind of lecture him, but I really felt uncomfortable doing that". Therefore it seems more reasonable to assume that the designer must concentrate on obtaining the big picture and must postpone paraphrasing and asking in-depth questions until a later point in the interaction. A great deal of reflection and problem-solving was required to develop a conceptualization of the SME's content area.

In spite of the original prediction, interspersing the teachback procedure (Gregory, 1986; Pask, 1975) in the interviews may actually interrupt the SME in the midst of an explanation and prove counterproductive to the overall goal of the elicitation process. A SME may require total concentration when explaining a complex sequence. If the instructional designer interrupts the SME, the SME may lose the train of thought and be prevented from explaining crucial information. The SME may also simply become irritated at being interrupted, thus affecting the rapport between the designer and the SME.

It would appear that the teachback procedure is more appropriately used at the beginning of a subsequent interview. With the aid of the knowledge map, John found this a powerful means of checking his understanding of the content against the expertise of the SME. John gathered the information in the interview, reflected on the content, constructed the map and then taught the material back to the SME at the beginning of each interview. This proved an effective adaptation of the CPP over what was originally conceived.

Conclusion

This study explored the development, trial, training and application of a process to elicit and conceptualize unfamiliar content. In particular the study examined the personal strategies used by the designer in handling unfamiliar content. A secondary purpose was to examine the effectiveness of the process to train designers in elicitation and conceptualization processes.

This study has examined the front-end investigation of eliciting and conceptualizing unfamiliar content by an instructional designer. The work is significant as it has carefully documented the interactions of a novice designer with SME's in a real context. The process appears promising in assisting the conceptualization of unfamiliar content and improving the designer–SME interaction. Further research needs to be undertaken with a variety of designers and SME's to determine the applicability of this process for the field of instructional design.

Epilogue—A Personal Note

Since conducting this study the researcher has employed the CPP to interact with over forty-six subject matter experts in the oil and gas industry in Canada from July 1993 to July 1994. Content areas included cementing, acidizing, fracturing, coil tubing, pipeline pigging, hydrostatic testing, vehicle inspections, nitrogen and CO_2. Comments by the SME's in relation to this process were very favourable. SME's were often puzzled by the accuracy of the information documented in the training manuals by an individual who was totally unfamiliar with the content. The operational procedures for twelve oil and gas operations relied exclusively on the input of SME's. The training materials were developed without actually observing the operations within the field setting. During 1994, I also worked with seven content experts in therapeutic massage. My role was to assist in the formulation of the curriculum. From August 1994 to February 1998 in Australia, I worked with over thirty subject matter experts in the development of multimedia training materials for industry and university-based clients. Some of these content areas included open cut coal mining, underground coal mining, automotive practices, alumina processing and engineering. This collaborative approach has proven to be successful in the completion of the technical projects. From February 1998 I have been working with medical subject matter experts at a medical school in Australia. I have utilised principles from the CPP to interact with over thirty medical experts in developing multimedia modules for use by medical students. Clients appear to "buy into" the process once they realize that their expertise drives the project. The role of the instructional designer is to filter and shape the content for the audience. My own experience in working with SME's has been favorable. In the project-driven environment in which I work, the identification and interaction with the SME is a major factor that determines the success or failure of the project. For me the CPP has continued to "work" and provide a valuable contribution to the design and development of multimedia modules.

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Defining the Dimensions of a Formative Evaluation Program: A Multi-Method, Multi-Perspective Approach to the Evaluation of Multimedia.

Gregor E. Kennedy
Biomedical Multimedia Unit, Faculty Of Medicine, Dentistry and Health Sciences,
The University of Melbourne. Australia.
g.kennedy@medicine.unimelb.edu.au

Abstract: This paper details the dimensions of a formative evaluation program developed to refine and improve computer aided learning (CAL) modules in the Faculty of Medicine, Dentistry and Health Sciences at the University of Melbourne. Evaluation criteria were developed in three domains and are broadly based on the characteristics of a CAL module. The program of evaluation which has been developed incorporates a variety of perspectives and a number of data collection techniques or methodologies. The program of formative evaluation is divided into four stages and is integrated with the development cycle of a CAL module. Each stage employs a different methodology. An advantage of this program of formative evaluation is its applicability in a number of multimedia education development environments.

Introduction

A number of developments in recent years have led to the need for a more formal approach to the evaluation of multimedia technologies within the Faculty of Medicine, Dentistry and Health Sciences at the University of Melbourne. First, consistent with the University wide push to develop multimedia teaching methods in higher education, more energy has been directed into developing multimedia education packages for courses offered across the Faculty. Second, as of semester one 1999, a new problem-based curriculum was introduced for students completing a degree in Medicine at the University of Melbourne. A key feature of the new medical curriculum is the emphasis placed on computer aided learning (CAL) which is consistent with a self-directed approach to teaching and learning. This self-directed approach will complement traditional lectures and practical sessions. Seventeen multimedia education projects were undertaken in 1998 by the Faculty, the majority of which will be used to develop computer aided learning modules to support the new medical curriculum.

In order to assist with the design and development of multimedia technologies, the Biomedical Multimedia Unit (BMU) was established in the Faculty. In addition to assisting with project management, instructional design, graphic design and multimedia authoring, part of the BMU's role was to assist Faculty members with the evaluation of their multimedia projects. This paper reports on how the BMU approached the formative evaluation of multimedia technologies being developed in the Faculty and the rationale associated with it. Three evaluation dimensions were considered instrumental to an effective program of formative evaluation. These were (i) the criteria for evaluation (ii) the participants in the evaluation and (iii) the data collection techniques or methods. While many researchers have considered these dimensions more generally, it was thought that an effective program of evaluation required a more specific approach, and an articulation of the interaction between these variables. In addition, it was thought that the program of formative evaluation should be integrated with the CAL module development cycle.

Defining Evaluation Criteria

In general terms evaluation has been conceptualised as either formative or summative. Knapper (1980) has noted the debate as to whether educational evaluation should focus on the end product of instruction and its impact or effectiveness (summative evaluation) or whether evaluation should concern itself with the process of refining and improving instruction (formative evaluation). While the goals of these two approaches may, at times, be incompatible, a comprehensive program of evaluation should attempt to cover both areas. That is, it is important to attempt to refine and improve a CAL module through formative evaluation and it is also crucial to document the impact and effectiveness of a CAL module through summative evaluation once it has been produced. The focus of this paper is on the formative evaluation process and thus concerns the refinement and improvement of a CAL module.

If the aim of formative evaluation is the refinement and improvement of a CAL module, then the way in which this can be brought about must be determined. The starting point for this process is making judgements about the "quality" (Dick & Carey, 1991) or the "value" and "worth" (Guba & Lincoln, 1981) of a CAL module. Evaluators in the field of multimedia education are, as a result, faced with a question. What criteria will be used to judge the value and worth of a CAL module? Will these criteria be based on students' learning outcomes or will they be based on the characteristics of the learning module itself? Researchers have used both these sets of criteria in the formative evaluation process, but often place different degrees of emphasis on each. For example, Dick and Carey (1991) argue that while formative evaluation is aimed at revising the module and is an iterative process, it primarily concerns the "collection and interpretation of learner performance data" (p. 261). Alternatively, Hannafin and Peck (1988) have developed formative evaluation criteria based predominantly on the characteristics of the CAL and issues associated with its implementation. Others, such as Reeves and Lent (1984) present evaluation criteria based both on educational outcomes and characteristics of the CAL module.

There are a number of difficulties with restricting formative evaluation criteria solely to learning outcome measures. As will be argued below, formative evaluation of multimedia can begin before the content of instruction has reached the computer screen. Pragmatically, it may not be feasible to assess students' learning outcomes if the module is far from completion. If learning outcomes are used as formative evaluation criteria other problems emerge. If the proposed learning objectives are *not* found to be adequately met it may be difficult to determine why this is the case. That is, using this form of assessment it is difficult to determine the value of discrete features of the CAL module. Are the learning objectives not being met because of the illogical sequence of content, the poor navigation system in the module, or the inability of the module to engage the learner? This does not imply that the assessment of students' learning outcomes is not integral to the evaluation of CAL modules. Rather, it is argued that the assessment of students' learning outcomes may be more appropriately applied in the final stages of formative evaluation or during a program of summative evaluation.

An alternative to basing formative evaluation criteria on learning outcomes is basing them on the characteristics of the CAL module. If a program of formative evaluation is predominantly based on the characteristics of the CAL module, this program could lead seamlessly into a program of summative evaluation where the assessment of learning outcomes would become paramount. If it is accepted that formative evaluation can be based primarily on the characteristics of a CAL module, researchers and evaluators need to determine suitable criteria with which to judge CAL modules. These criteria should reflect the mechanisms or attributes of a CAL module which theoretically assist student learning. Numerous researchers in the past have developed such criteria based on theories and models of learning and instruction.

Criteria used to Evaluate CAL Modules in the Faculty

The criteria formed to evaluate the development and design of CAL modules in the Faculty were based on theories of learning and instruction (eg. Gagne, 1985; Hannafin & Peck, 1988; Hannafin & Reiber, 1989a, 1989b; Herrington & Oliver, 1997; Oliver & Herrington, 1995; Overbaugh, 1994; Park & Hannafin, 1993; Reigeluth, 1983; Schmidt, 1993: Shuell, 1980) and the criteria researchers have used to evaluate multimedia programs in the past (Hannafin & Peck, 1988; Kearsley 1985; Reeves & Harmon, 1994; Schueckler & Shuell, 1989; Shuell & Schueckler, 1989). Primary and common features which emerged from this literature review were taken to form the formative evaluation criteria. These features were classified into three general domains: Instructional and Conceptual Design, Interface and Graphic Design and User Attitudes and Affect.

A review of the characteristics of the specific sub-criteria contained in each of these three evaluation domains is presented elsewhere (Kennedy, Petrovic & Keppell, 1998), however, a summary is presented below. Five sub-criteria are contained in the domain of Instructional and Conceptual Design: introductory objectives and directions, navigation and orientation, interactivity, sequencing and structure, and consistency between learning objectives and content of instruction. The sub-criteria in the domain of Interface and Graphic Design were initially organised by the primary features of the interface; namely, colour, text, structure and sound, animations and graphics. Each of these interface components is evaluated through general questions relating to issues such as useability, consistency and clarity. Other than this more general evaluation, specific principles of "best practice" were determined for each component of the interface on the basis of previous research. The degree to which particular CAL modules conform to these notions of "best practice" is also evaluated. The final domain, User Attitudes and Affect, incorporated aspects of the first two domains. Evaluation centres on student users and asks them to evaluate aspects of Instructional and Conceptual Design and Interface and Graphic Design. In addition, users are asked to evaluate modules more generally, commenting on criteria such as effectiveness, usefulness, enjoyability, appeal, user-friendliness, relevancy and engagement

Methodology of Evaluation

Once the formative evaluation criteria were determined a method of evaluation needed to be decided upon. Within the field of education, a considerable amount has been written on the methodology associated with formative evaluation generally, and of multimedia in particular (see Alexander & Hedberg, 1998; Dick & Carey, 1991; Draper, 1995, 1997; Flagg, 1990; Guba & Lincoln, 1981; Hannafin & Peck, 1988; Knapper, 1980; Reeves, 1989, 1993a, 1993b; Reeves & Lent, 1984; Wills & McNaught, 1996). From a review of this literature the methodology associated with formative evaluation was seen to have two key components: the individuals who participate in the evaluation and the data collection techniques employed.

Evaluation Participants

It is generally recognised that the participants in formative evaluation can be "experts" and potential "users" (Dick & Carey, 1991; Flagg, 1990; Hannafin & Peck, 1988; Reeves, 1993b; Reeves & Lent, 1984). Flagg (1990) categorised experts into four areas including subject matter, media, design, and utilization experts. Similarly, Reeves (1993b) argued that experts such as content or subject matter experts, instructional experts and teachers and trainers can all provide valuable and unique contributions to the development of a CAL module. In an educational setting "users" are usually thought of as students who will eventually complete the module.

There were a number of reasons to consider a variety of perspectives in the formative evaluation process. First, it seemed that some criteria could not be reliably evaluated by users while others could not be reliably reflected upon by experts. For example, it is unlikely that a content expert, who has invested much time and effort in creating a multimedia module, will indicate that the module contains a lot of distracting or irrelevant information. Similarly, it may be difficult for a student to judge how the structure and content of the module enhanced the communication of the learning objectives. The second reason to evaluate CAL modules from a variety of perspectives was the advantage of highlighting any disparities which exist between the perceptions of CAL module users and content experts or developers. Some researchers have remarked that educational and content experts may agree that a particular feature of a CAL module is worthwhile only to find that the same feature is seen to be irrelevant, distracting or confusing for the learner (Reeves, 1993b). For these reasons it was decided that the program of formative evaluation in the Faculty would include four perspectives: those of content experts, graphic design experts, educational experts and CAL module users.

Evaluation Data Collection Techniques

Just as evaluators have suggested a variety of perspectives in the evaluation process, a number of data collection techniques have also been advocated. Dick and Carey (1991) suggest the use of one-to-one trials, small group trials and field trials as evaluation procedures. Reeves and Lent (1994) on the other hand argue that formative evaluation should be based on internal reviews and operational testing involving questionnaires, expert review, observation and interviews. It is important to use a variety of measures or data collection techniques in the process of evaluation. This enables evaluators to obtain an indication of the validity of the assessment of constructs through the processes of triangulation and bracketing. Often this process will aid in the interpretation of evaluation results.

However, before a decision can be made about the type of methodology to be employed, a number of pragmatic issues needed to be considered. Reeves and Lent (1984) noted that "Unfortunately, few CBI development projects have the budget or time-line to spend large amounts of money and time on these [evaluation] procedures" (p. 195). Commonly formative evaluation is constrained by the availability of time and money. An additional constraint in the current context was the availability of students for evaluation. Due to the large number of multimedia projects being developed in the Faculty, CAL module users were regarded as a scarce resource. The developers of the program of evaluation were wary of over-evaluating students, and in the long term, undermining the reliability of their responses. There was a need, therefore, to develop a method of formative evaluation which accommodated these restrictions yet produced data which was able to assist in the refinement and improvement of the CAL modules being developed. Keeping these constraints in mind, four means of data collection were determined for the current program of formative evaluation: expert review, questionnaire, focus group and observation.

Stages of Formative Evaluation

The program of formative evaluation was divided into four stages. These stages were integrated with the development cycle of a CAL module (see Figure 1). It should be noted from Figure 1 that the four stages of evaluation overlap and that as a module approaches the beta version in the development cycle an initial assessment of users' learning outcomes would begin. A number of evaluation resources have been developed to be used in the evaluation program, including qualitative and quantitative template questionnaires and checklists (Kennedy, 1998). There is a reliance on questionnaires and expert review as the major form of data collection as these are the most cost-effective and convenient forms of data collection. Rather than being prescriptive to Faculty staff about the use evaluation resources, an array of resources was developed to account for different evaluation questions and methodologies.

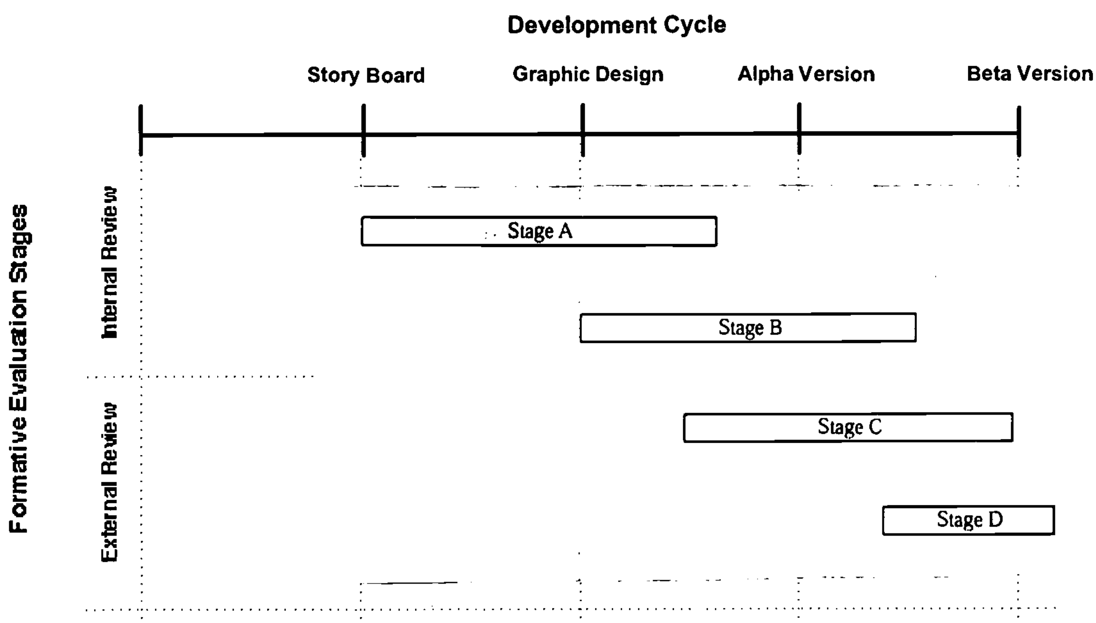

Figure 1: The stages of the proposed formative evaluation program integrated with the CAL module development cycle.

The first two stages of the program of evaluation (Stages A and B) consist of internal reviews of instructional and conceptual design and interface and graphic design. These reviews are both formal (written reports) and informal (verbal discussion and feedback) and are carried out by content experts, graphic design experts and instructional designers associated with the module's development. Stage C is the most extensive stage of the program of formative evaluation and incorporates both instructional and conceptual design and interface and graphic design. Reviews are conducted externally (that is, by individuals not associated with the module's development) and from a number of perspectives (content experts, graphic design experts, instructional designers and student users). In the final stage (Stage D) the domain of User Attitudes and Affect is evaluated and is restricted to the perspectives of student users. Three forms of data collection are used in this stage (questionnaire, focus group and observation).

Implications and Applications

The utility of the proposed program of formative evaluation lies in the fact that it is not dependent on the content area of a particular learning module, and therefore may be easily applied in any context where educational software is being developed. The criteria for evaluation, rather than being based on students' learning outcomes, are based on the characteristics of CAL modules. This allows the program to be easily transferred to other educational contexts. While the program of evaluation was developed to evaluate a number of CAL modules across a variety of disciplines, it should be noted that it can also be applied by smaller development teams. The program of formative evaluation outlined above provides a solid foundation for the development of a commensurate program of summative evaluation. It is hoped that when used together these evaluation programs will foster the development of educationally effective CAL modules.

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Alternate Teaching Models for Non-Classroom-Based Instruction

Emery S. Martindale
University of West Florida
11000 University Parkway Bldg 85 Room 160
Pensacola, FL 32514
martindale@uwf.edu

Abstract: This paper attempts to justify the need for the use of alternative teaching models in non-classroom-based instruction (NCBI). Disproportionally high drop-out and failure rates, along with unnecessary constraints from behavioral teaching models necessitate the examination of alternative models. Social models such as small group discussion and information processing models such as concept attainment may more effectively utilize new delivery methods such as the World Wide Web. More research using these teaching models may aid instructional designers in selecting the most appropriate instructional model for a particular audience and instructional problem.

Introduction

As the United States moves from an economy based on manufacturing to one based on information, the need for information-literate employees is rapidly growing. Public education is currently under scrutiny from business and industry, and is being criticized for being slow-moving and overly conservative, particularly in terms of implementing computer technology. Commercial institutions expect the same productivity gains in education that have occurred in business. Computer instruction and the Internet in particular has been widely promoted as the ultimate instructional tool to replace schools and teachers (Perelman, 1994). Some promoters of computers and networks in education believe that traditional classroom-based instruction will become unnecessary as computers become less expensive and more ubiquitous. More research on non-traditional educational methods is certainly in order in response to cries for educational reform.

Non-classroom-based instruction (NCBI) can be defined as any planned learning environment that is not designed to occur in the traditional classroom. NCBI includes all forms of distance education, as well as campus-based self-paced courses and other self-paced learning environments. This type of instruction is becoming much more common, particularly due to the growth of computer networks (Harasim, 1995). With the rapid expansion of NCBI there is a need to examine its effectiveness in terms of instructional design. A primary method of evaluating various forms of NCBI lies in the examination of the teaching model employed in the design of the instruction.

Teaching models are approaches to teaching with underlying theoretical support that are designed to bring about a particular type of learning (Joyce, 1992). Joyce groups the various teaching models into "families" based on the learning theories from which the models have been derived. A learning theory can be defined as a set of principles and observations derived from research that support a hypothesis of how learning takes place (Ormrod, 1995). Models for delivery have been constructed around the tenets of certain learning theories. According to Joyce (1992), teaching models can be grouped into four "families". These families include behavioral models, social models, information-processing models, and personal models. Following is a brief summary of three of these families of teaching models. Personal models will not be discussed as they are beyond the scope of this paper.

Behavioral Teaching Models

On the foundation of the work of Skinner, a large number of approaches to learning have been developed, each taking advantage of the human being's ability to modify behavior in response to tasks and feedback. These models are used in a wide variety of applications, from teaching information to changing habits, decreasing phobias, and learning to control one's own behavior.

One of the important applications of behavioral systems theory is in the development of systems that enable learning tasks to be regulated according to the progress of the learners and which teach students to pace themselves for optimal performance. Often these systems organize material to be learned in small sequenced instructional modules that are presented to the students with assessments of learning embedded in them (Joyce, 1992). Some of these behaviorally-based teaching models include mastery learning, direct instruction, contingency management, and self-training through simulation.

Social Teaching Models

These teaching models capitalize on our nature as social creatures to further learning and to expand our ability to relate productively to one another. The models range from the simple processes or organizing students to work together to elaborate models that teach democratic social organization and the analysis of major social problems and critical social values and issues. The social models of teaching are constructed to take advantage of the "synergy" phenomenon -- the collective energy generated by group work. The simplest forms of cooperative learning organize students to help one another respond to the cognitive and social tasks presented to them. More advanced models prepare students for life in a democratic society -- an idea developed by Dewey (1916).

Many developers of the social models believe not only that they have developed important additions to the storehouse of models but also that the current state of affairs -- teacher-dominated recitation -- is actually counter-productive for individuals and society by depressing learning rates, creating an unnatural and even antisocial climate, and failing to provide opportunities for young people to maximize their potential through cooperation. Current social teaching models to be considered include partners in learning (dyads), cooperative learning, role playing, and jurisprudential inquiry (Joyce, 1992).

Information Processing Teaching Models

Information processing theory is concerned with how humans acquire, process, and remember information. This is contrasted with behaviorism's concern with measurable behavior change and lack of concern over mental events or cognition. A number of teaching models seek to discover these mental events and create effective environments for processing information (Pressley, 1995).

These models are designed to increase students' ability to seek and master information, organize it, build and test hypotheses, and apply what they are learning in their independent reading and writing and their exploration of themselves and the world about them. Some of these models induce the students to collect information and build concepts. Others teach them to profit from direct instruction through readings, lectures, and instructional systems. Some of the information processing models include thinking inductively, concept attainment, memorization, advance organizers, and inquiry training (Joyce, 1992).

Teaching Models for NCBI

The preceding teaching models have been widely used in traditional classroom-based educational environments. However, many instructional situations and opportunities exist outside the school classroom. These instructional situations, identified as non-classroom-based instruction (NCBI) operate outside of traditional face-to-face interaction with an instructor, so alternative delivery methods must be considered. NCBI has been and is currently being delivered via print, radio, television, and computer network. Following is a discussion of the teaching models employed within these delivery methods.

NCBI Delivered via Print

NCBI consists of distance education courses as well as school or campus-based self-paced courses. Distance education, traditionally defined, is an environment in which instructor and audience are separated by time or distance or both. While NCBI may seem to be a recent phenomenon, print-based correspondence courses have been in existence for over 150 years (Holmberg, 1996). These early examples of NCBI consisted of courses offered through newspapers and through printed mailings using the postal service. Print-based correspondence courses are still used today although they are now commonly combined with electronically-delivered material (Moore, 1995).

Print-delivered NCBI has traditionally relied upon behaviorally-based teaching models, particularly direct instruction and mastery learning (see Price, 1996). The common design uses short modules of instructional content followed by a self-test and then a formal assessment, most often using techniques that require low-level processing, such as multiple choice tests, matching, and filling in blanks. Course objectives are stated in behavioral terms. The student may conduct an internal dialogue with the material, but has little to no interaction with a live instructor or with other students. Collaborative learning is discouraged in these instructional situations.

The most common model for print course development is the author-editor model. Authors (often professors) are contracted to write a course, which is then edited by specialists within the correspondence school or independent studies department. In most cases the correspondence material consists of units that include a statement of lesson objectives, a reading assignment, a commentary and a study guide, and a written assignment to be completed (Moore, 1993).

NCBI Delivered via Electronic Communications

Electronic communications for education also began in the 1920s with radio programs. These programs most often focused on fundamental instruction, usually in language and mathematics (Cuban, 1986). In the 1930s experimental television programs were being produced at a few pioneering universities, and programming expanded in the next few decades. These radio and television programs were not interactive, with no student feedback or discussion with the instructor. Content was commonly delivered by a "talking head" -- meaning an instructor faced the camera or microphone and delivered a prepared lecture (Cuban, 1986). This delivery method operates within artificial constraints that are not set in place by the television medium.

Satellite technology, developed in the 1960s and made cost effective in the 1980s, enabled the rapid spread of instructional television. Televised courses have now become more interactive with the deployment of distance education equipment including cameras and microphones for the students at remote and local sites as well as for the instructors. Still the teaching model most commonly used is direct instruction, with the instructor lecturing to a group of students whether in person or at a remote site (Gilbert, Temple, & Underwood, 1991).

The last ten years have seen an exponential growth of microcomputers in homes and schools in the United States (Williams, 1996). As microcomputer access has grown, so has computer-based instruction (CBI). CBI began as an outgrowth of Skinner's programmed instruction. Because of this, much of CBI has followed the drill-and-practice behavioral model (Price, 1991). The development of the CD-ROM greatly increased the storage capacity for commercial and educational software, and this increased storage has led to the creation of multimedia titles that are rich in sound, video, and animation. While these attributes in themselves do not lead to alternative teaching models, multimedia titles tend to be more learner-centered in terms of user control and non-linear progression through the material.

The distribution of Apple Computer's HyperCard authoring environment contributed to the development of hypertext and hypermedia programs in CBI. Proponents of these programs claim that they model human associative memory and thus can serve as powerful cognitive amplifiers (Conklin, 1987). Hypertext CBI is related more to information processing than behavioral models, and these types of applications have become much more prevalent with the growth of the World Wide Web.

NCBI Delivered via Computer Networks

With the widespread proliferation of personal computers and the growth of the Internet, online distance education is a rapidly growing segment of NCBI that serves as an educational alternative to traditional face-to-face instruction. The ubiquity and ease of use of the World Wide Web has led to a large expansion of online courses in higher education. In the United States, the American Open University, Nova University, and the University of Phoenix have been traditional leaders in providing distance education. These and many other universities are now offering hundreds of courses online (Lintz & Tognotti, 1996).

Computer networks offer new opportunities for collaboration in NCBI. Protocols and software tools such as e-mail, mailing lists, newsgroups, chat, and instant messaging allow several modes of interaction. Interaction modes can be classified as one-to-one, one-to-many, and many-to-many (Harasim, 1990). The Internet is a medium that removes many of the constraints of print, radio, and television delivery mediums. Communication can occur in real time or asynchronously, allowing interaction with both instructor and fellow students. Distributing material over networks is much less expensive than television production and more expedient than print correspondence. It would seem to be a superior medium for many types of instruction. But as in print correspondence and earlier electronic media in their initial years of use, network-delivered NCBI has relied primarily on behavioral teaching models, most often direct instruction and mastery learning. This is evidenced by current Web-based online course offerings (see WebLearning, 1998; Real Education, 1998).

Current Practice

Many educational institutions as well as businesses and other organizations are providing Web-based courses for students and employees. However a large segment of this non-classroom-based online coursework remains exclusively in the domain of the behavioral family of teaching models, despite evidence of the effectiveness of alternate teaching models.

The effectiveness of the current state of NCBI is under scrutiny, particularly as institutions prepare to embark upon major distance education initiatives. Drop-out rates for correspondence courses are disproportionately high (Kember, 1989). Similarly, in a pilot study the researcher found that students in a campus-based self-paced course demonstrated unusually high failure rates. The nature of NCBI places responsibility for learning upon students who may have never faced such requirements.

For behavioral teaching models there are other concerns beyond high failure and drop-out rates. In the context of an online course these models do not take advantage of the available attributes of the http protocol. These attributes include the availability of asynchronous interaction and discussion with the instructor or classmates, and hypertext associational linking between related topics. This linking may mirror the hypothesized information processes in human cognition. Behavioral models, therefore, work within artificial constraints not imposed by the http protocol.

The dominance of behavioral models in NCBI can be explained in terms of misperception and convenience. Behavioral teaching models are perceived to present low instructor demands in terms of time and design expertise. Behavioral models such as direct instruction and mastery learning seem to be simply and conveniently translated into printed or online "study guides" which lead the learner step-by-step through the particular instructional content. Often these materials are organized into instructional "modules" which can be easily assessed for effectiveness (see Price, 1996).

In order to achieve the interaction required by social and information processing teaching models, NCBI (whether print-based or Internet-based) is perceived to require greater instructor time and resources, as well as more advanced design and programming techniques. The decision to use behavioral teaching models in NCBI may therefore be based on perceived convenience rather than effectiveness and appropriateness toward reaching the instructional goal.

Teaching models from the information processing and social interaction families do not necessarily require greater instructor time or resources to implement. Alternative online course design and specialized software present an opportunity to use these models efficiently. These alternative designs need to be compared and contrasted with designs from behavioral teaching models such as direct instruction and mastery learning which currently dominate NCBI environments.

Alternative Teaching Models for NCBI

The following two teaching models are proposed as alternatives to the behavioral models widely used in NCBI. Small group discussion is from the social interaction family of models and concept attainment is from the information processing family of models.

Small Group Discussion

The challenge of the current state of affairs is to design effective NCBI using teaching models beyond simple direct instruction or mastery learning. The evidence is largely affirmative that cooperative groups do result in improved learning. Classrooms organized so that students work in pairs and larger groups, tutor each other, and share rewards are characterized by greater mastery of material than the common individual-study and recitation pattern. Also, the shared responsibility and interaction produce more positive feelings toward tasks and others, generate better intergroup relations, and result in better self-images for students with histories of poor achievement. The results generally affirm the assumptions that underlie the use of cooperative learning methods (Sharan, 1990).

Beyond traditional face-to-face instructional situations, the effectiveness of group discussion and collaboration has also been shown effective in distance education. With Internet delivery there are many cooperative learner approaches for effective instructional environments. These include online mentorships, tutor support, informal peer interaction, and expert forums. Online group learning structures include online seminars, small group discussions, learning partnerships and dyads, learning circles, and teaching and presentations by the learners. Role playing simulations, online debates, and informal chat areas are also viable instructional environments (Harasim, 1995). Many of these learner approaches can be classified as online asynchronous group instruction. Specialized network software such as the IdeaWeb (Ahern, 1992) can be used for small group discussion and collaboration in online environments as a type of computer-mediated communication (CMC). The IdeaWeb represents an opportunity to utilize the advantages of the http protocol in creating a collaborative learning environment within NCBI.

Concept Attainment

Among the information-processing models found within traditional education, the concept attainment model is a viable choice for instructional use in NCBI. The concept attainment model of instruction can be defined as the search for and listing of attributes that can be used to distinguish exemplars from non exemplars of various categories. The model requires students to compare and contrast exemplars that contain characteristics (called "attributes") of the concept with exemplars that do not contain those attributes. Exemplars are a subset of data from a data set. Positive exemplars are the subset examples that share one or more defining characteristics that are missing in the other examples. It is by comparing the positive exemplars and contrasting them with the negative ones that the concept is learned.

Learning by concept attainment involves two phases. First, the concept name is presented along with labeled examples of positive and negative exemplars. The learner integrates these exemplars and generates a hypothesis about the concept definition. The student then states a possible definition in terms of essential attributes. Secondly, the student identifies additional unlabeled examples as positive or negative exemplars of the concept. The student hypothesis and definition is either confirmed or corrected, and a correct definition of the concept is given. The student then generates more concept examples. By following this model the student learns the concepts related to the instructional content (Joyce, 1992). Using HTML, the author has previously developed concept attainment lessons for use in an NCBI environment.

Conclusion

This paper attempts to justify the need for the use of alternative teaching models in non-classroom-based instruction (NCBI). The author contends that behavioral teaching models are dominant in NCBI and that high failure and drop-out rates, along with unnecessary constraints from the behavioral models, necessitate the examination of alternative models of teaching. This paper examines two alternate teaching models: small group discussion from the social models classification, and concept attainment from the information-processing models classification. Instructional systems using these models can be asynchronous and do not necessarily require additional instructor time or resources in terms of class management. Instructional effectiveness can potentially be increased without significantly increased instructor resources. Empirical research on teaching models should be conducted to examine the level of effectiveness of these particular teaching models for NCBI. This type of research will aid course designers in selecting the most appropriate instructional model for a particular audience and instructional problem.

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Exploring Conceptions of Educational Technology between France and Texas

Karen L. Murphy
Department of Educational Curriculum and Instruction
Texas A&M University
United States
kmurphy@tamu.edu

Lauren Cifuentes
Department of Educational Curriculum and Instruction
Texas A&M University
United States
laurenc@tamu.edu

Abstract: This study investigated a virtual partnership between educational technology graduate students in France and Texas. The partnership was designed initially for the students to communicate their conceptions of educational technology primarily via a Web message board. We used qualitative research methods to identify the Texas students' descriptions of their participation in and reactions to the partnership and their ideas about educational technology in the U.S. The investigation tested an existing model of six design considerations for computer conferencing (grading system, grouping, collaboration, relevance, learner control, and technological preparation) and four design considerations for cross-cultural participation via communication technologies (communication and interaction, language, content, and representation form). We discovered that unless each design consideration is addressed, cross-cultural partnership via telecommunications may be unsuccessful.

Introduction

Graduate students preparing to work in the field of educational technology and multimedia subsequently find positions as administrators and faculty members in K-12 settings, community colleges and universities; and as trainers and instructional designers in the public and private sectors. Students graduating from programs in educational technology and multimedia require specialized telecommunications and multimedia skills and face an increased emphasis on international communication in their work. Romiszowski (1997) identifies critical thinking, or creative problem solving, of "paramount importance for the knowledge worker of the future and, therefore, ultimately, for the employability of the human race" (p. 33). A study of Texas employers identified multilingual skills as vital and increasingly required for success. Other requisite skills include: written and verbal presentation skills, ability to think logically, sound judgment, ability to work in multicultural teams, flexibility in adapting to change, and ethical decision making (Zey, Luedke, & Murdock, 1999). In preparation for such work, graduate students can expand their horizons about the role of educational technology and multimedia in an international arena by using the Internet to communicate and collaborate across international boundaries. In this cross-classroom partnership, graduate students in educational technology at Texas A&M University (TAMU) in the US and the University of Poitiers (UP) in France used telecommunications to share ideas on topics related to their studies.

The Project

Graduate students in educational technology at TAMU in the US and at UP in France were linked through an electronic communication exchange designed to expand participating students' conceptions about the graduate programs and the role of educational technology. The course for TAMU students began at the end of August, whereas the UP students began their course six weeks later. The TAMU students met weekly via interactive videoconference and FirstClass computer conference software to discuss topics, post assignments, and develop small group projects. The UP students, on the other hand, were in a traditional face-to-face class: lectures, labs, problem-solving using varied technologies; the course culminated with a three-month internship in a company.

The TAMU and UP educational technology instructors had collaboratively developed the partnership activities, which included: 1) development of student biographies as individual Web pages, 2) class discussions at both universities, 3) a one-hour videoconference, 4) three discussions via message boards on the Web over a six-week period among mixed groups of students, and 5) a follow-up survey. The TAMU instructor assigned 10% of her students' grades to this project, whereas the UP instructor informed his students that participation in the project was required but did not assign specific points.

The first activity was for the students to create and publish their individual biographies on the Web. The second activity, class discussions at both universities, addressed the logistics of the partnership activities, guidelines for using the Web board, and communication issues between the two universities. The third activity was a one-hour interactive videoconference, which included the instructors and nearly all of the students from both countries. The videoconference included introductions of faculty and students, and small group discussions. Each group of eight students took turns sharing backgrounds and interests with each other as well as making plans for their Web discussions. The videoconference culminated with a demonstration of the Web message board.

The fourth activity was a series of discussions on a Web message board about the roles of educational technology. The TAMU instructor developed six identical Web boards, which allow users to post new messages, reply to questions and other replies, and search for a string of characters within messages. Separate boards were built for each group of eight students, four from each university. We planned that during a six week period, the six groups would discuss three topics for two weeks each: 1) the role of educational technology at their universities; 2) the role of educational technology in their countries; and 3) the formation of their own conceptions of educational technology. Six TAMU students, one from each group, were designated to moderate the first discussion topic for their groups, thereby modeling appropriate computer conferencing behaviors for the UP students, whose coursework had only recently begun. The TAMU instructor first entered the welcome messages and instructions. Then six student moderators each entered the first set of three discussion questions regarding educational technology in the universities. During the first two-week period, each TAMU student entered at least one reply to the three-part discussion, while most students replied several times. Then they waited for responses from UP. However, only one UP student participated, replying to each of the three questions in her discussion.

The final activity was a follow-up survey administered in March 1999. The TAMU students received their surveys by email, and the UP students received theirs on paper. The survey collected demographic data, investigated conceptions about educational technology in the two countries, and sought reactions to participation in the partnership.

Methods

Participants

This partnership included TAMU in College Station, in central Texas, and the UP, in central France. Participants included 24 graduate students from TAMU and 22 from UP. With one exception, the TAMU students were enrolled in a semester-long course in educational technology earning master's or doctoral degrees in education. All 22 UP students were post-graduates in the master's degree program consisting of coursework on campus followed by internships throughout the country. The UP students, who were primarily from France and included several students from Romania, remained as a cohort throughout the year-long program.

Data Sources

The data sources included the messages from the six Web boards and the follow-up survey results from 17 TAMU students. We downloaded the messages from the six Web board discussions, and we coded the responses on the surveys. The data were coded according to T for TAMU, a student number between 1 and 24, and "s" for survey or "w" for Web board. We analyzed the data by using the constant comparative method.

Research Questions and Procedures

The initial research questions dealt with an investigation of students' conceptions of educational technology in the two countries and identification of the conceptions that were shared across borders. However, because of the lack of participation by UP students, we changed our research focus to the actual partnership experience. We investigated the following topics:

1. What were TAMU students' conceptions about educational technology?
2. How did TAMU students' describe their participation in and reactions to the partnership?

In addition, we wanted to identify key ingredients of successful cross-cultural partnerships. Therefore, after analyzing the data, we critiqued the data based on two design models, one of computer conferencing and the other of cross-cultural collaboration. Doing so allowed us to identify which factors were not addressed in the partnership and therefore may have been responsible for the failure to achieve the objectives.

Results

Based upon the existing data, we report here on findings regarding the partnership. The TAMU students reported spending approximately 1.5 hours in class discussing aspects of the partnership. The means of student hours spent on the three activities associated with the partnership follows: creating a Web-based biography (mean = .87 hours), videoconferencing (mean = 1.02 hours), and Web board discussion (mean = 1.44 hours). Therefore, the mean amount of time spent on the partnership per student was 2.42 hours. All TAMU students created a Web-based biography and participated in the Web board. Although the videoconference was held on a Saturday and was optional, 20 of the 24 TAMU students attended.

Conceptions of Educational Technology: The US Perspective

Students perceived the role of educational technology in schools, business, and government as a growing entity for facilitating learning, supporting communication, and conducting research. In schools, educational technology enhances student learning primarily through application to problem solving, a skill that they will transfer to situations outside of school. The TAMU students identified problems associated with technology in the schools. "Schools are quickly realizing how important technology has become...In many cases, however, teachers are not trained on how to use the equipment. They also may not be trained on how to integrate the technology into their teaching scheme" (T19s). Another student expressed concern that some people believe technology "could 'replace' a teacher" (T2s). In business, educational technology facilitates training of personnel, sharing of ideas through telecommunications and presentations, and providing instructional programs and testing methods. The government sponsors "public awareness and informational programs and ...is attempting to help all schools access the Internet in order for all children to have access to information and experience with technology" (T16s).

Students reported forming their ideas about educational technology by discussing issues with their classmates, professors, colleagues, and others both face-face and through listservs; reading literature in the field; experiencing educational technology hands-on; conducting research; and solving educational and technological problems. They acknowledged the importance of educational technology and maintained a positive attitude that makes them receptive to learning: "I realize more and more each day the importance of learning to use it so I can function in today's society" (T7s). They identified various elements in the popular culture that helped them shape their ideas about educational technology: television, magazines (including trade magazines), film, and videos.

The Partnership Experience: The US Perspective

The videoconference was the most popular activity of the partnership. Students enjoyed "being able to interact with people from a different culture and setting" (T11s) and "being able to SEE the French students" (T10s). One student suggested that future follow-up videoconferences should be held. Two students liked sharing biographies best of the activities, as one of them explained: "I enjoyed reading the biographies ...and finding out how their preparation was different from ours" (T22s).

TAMU students agreed that the concept of cross-cultural learning about educational technology was good but that in reality the experience was a great disappointment. The videoconference built up students' hopes that they could communicate with students in France. However, when TAMU students did not receive responses to their questions, they expressed frustration of checking the Web board frequently and finding no responses from UP.

The two TAMU students who expressed positive experience with the Web board imparted value on the process of cross-cultural communication itself. They noted the power of international dialogue, saying: "It ... forces you to...be precise in how you are saying what it is that you want to say" (T16s) and determining "the best way to organize the discussion to make it easy to follow for new users" (T22s). Both students examined their own processes and used the partnership to refine their approaches.

The TAMU students suggested that the instructors "make sure both groups are willing to follow through with what the collaboration entails" (T11s). They offered these suggestions to enhance collaboration: (a) clarify expectations to learners by setting "a minimum number of entries in a set time period" (T9s) and maintain contact with each other; (b) arrange for sufficient access to labs and equipment as well as training in using technology; and (c) enforce communication through guidance and grading of the activity.

The students felt that they had done everything possible to encourage the UP students. They suggested that the UP students demand lab time, be proactive, and make more effort to communicate. Despite limited communication, TAMU students learned from the partnership. Several students commented that a successful partnership involves careful planning and a commitment from both sides. However, one noted that "even the best planned initiative can be short-circuited by one problem - no open labs in Poiters" (T22s). Other students acknowledged the power of technology to bring people together from distant corners of the world. "In about an hour I had met a bunch of nice people on the other side of the globe. I saw their faces, their names and I heard them talking, just like if they had been in the same room with me" (T14s).

Through observations, email exchanges, and comments from the TAMU students, we identified probable reasons for the failed electronic exchange. Limited access, limited time to reply to messages, lack of understanding the power of asynchronicity or how to use the Web board, and lack of course credit for participation all led to the UP students' setting the partnership low on the priority list of course activities.

Discussion

The purpose for identifying the reasons that the partnership was ineffective for the goal of investigating cross-cultural understandings of educational technology was to provide a scholarly analysis of why this particular cross-cultural partnership did not achieve its goals. The broader purpose was to discover the key ingredients needed for successful partnerships across cultures. The literature describes cross-cultural partnerships and suggests successful designs of such partnerships via telecommunications. This literature is related to the following topics: (a) educational partnerships, (b) designing for computer conferencing, and (c) cross-cultural communication.

Educational Partnerships

The literature on university-school partnerships reveals important guidelines for successful partnerships of various types. Tushnet (1993) identifies the following characteristics of successful partnerships: a history of collaboration; addressing real problems as they occur; mutual respect for each other; and discussions with all players about the content of activities. Prior to the partnership, the TAMU and UP instructors had not shared their content or ways to use technology. Once problems such as unequal contributions by the students began to surface, the instructors failed to communicate regularly with each other and thus didn't address the problems.

Designing for Computer Conferencing

Increased use of computer-mediated communication for teaching and learning has created a developing body of literature on designing for online environments. Researchers propose six design considerations for computer conferencing: two that involve administrative design considerations--grading system and grouping--and four instructional design considerations--collaboration, relevance, learner control, and technological preparation (Cifuentes, Murphy, Segur, & Kodali, 1997). Each design considerations will be described and analyzed in terms of the partnership.

The two administrative design considerations were grading system and grouping. Research shows that student participation rates are influenced by whether participation is voluntary or required (Wells, 1992). In partnerships, grading should include a similar emphasis on both sides, and professors should collaborate on a grading scheme for all students. In this partnership, the grading emphasis was different, with the TAMU instructor assigning actual point values for participation, and the UP instructor requiring the activity but not placing point values on it. The second factor, grouping, concerns size, location of the members, and composition of the groups. Decisions about group formation are best made prior to partnership activities. The instructors were effective in establishing small groups and combining computer conferencing expertise and command of written English.

The four instructional design considerations were collaboration, relevance, learner control, and technological preparation. Collaboration involves a group created to perform a task or solve a problem together (Slavin, 1983). Romiszowski (1997) asserts that the most effective types of teaching-learning techniques to foster critical thinking skills are "experiential exercises followed by interpersonal interaction in small groups, and with facilitators to guide the group towards useful conclusions" (p. 33). Creating and playing adventure games on the Web, for example, have been found to improve foreign language skills (Vilmi & Malmi, 1996). In this study, the participants did not share a common task to be performed.

Relevance is necessary for meeting learners' needs and allowing them to profit directly. Relevance is related to authentic activities, the "ordinary practices of the culture" (Brown, Collins, & Duguid, 1989). Romiszowski (1997) recommends several authentic activities: small-group discussions, simulation games, project-based work, and collaborative problem-solving activities. The TAMU-UP partnership might have benefited from doing shared tasks in small groups rather than discussing educational technology.

Learner control is typically characterized by learners making choices in the pacing, sequence, and selection of instructional materials. Giving learners control over their learning environment is empowering, as Cifuentes et al. (1997) noted in regard to pre-service teachers who were allowed to co-moderate their own conferences. Had the students in the partnership between TAMU and UP been given the opportunity to select their own discussion moderators and share the moderating responsibilities between sites, they might have felt more empowered.

Technological preparation is imperative in helping students be competent with the technology. Hillman, Willis, and Gunawardena (1994) assert that "user-interface interaction" is critical, particularly with high technology communication devices. They suggest methods that foster comfort with a new technology like having students play with the tools in a game-like activity before using the tools for course content. The emphasis on technological preparation and uses of telecommunications should be similar at both sites. The TAMU students had been using computer conferencing for eight weeks by the time of the videoconference, whereas UP students hadn't used telecommunications other than the Web.

As Cifuentes et al. explain, "The design concern for including collaboration and relevance is to provide a social learning context in which students can work productively with each other and internalize their own individual learning. Similarly, student motivation can be ensured by allowing some learner control in the design. Finally, adequate technological preparation empowers students to successfully complete the tasks associated with computer conferencing (1997, p. 186).

Cross-cultural Communication

While the six design considerations were tested with university students in the US, they may also be appropriate for cross-cultural partnerships. Collis and Remmers (1997) report that at least four issues are related to effective cross-cultural Web design: communication and interaction; language; content; and representation form. These four issues, when interfaced with the six design considerations, may hold the key to successful cross-cultural partnerships. First, communication and interaction are easily misinterpreted across cultures. For example, in cross-cultural contexts more communication and interaction are not necessarily better than less, and well-structured communication, moderated by an individual with standing, may be preferable for wider audiences. In the TAMU-UP partnership, the two instructors could moderate the discussions themselves. Second, because language includes verbal and non-verbal communication, those developing cross-cultural sites must be sensitive to cultural differences in communication styles. Issues pertaining to selection of language(s), translation by multilingual people, and communication protocols all present potential problems. Combining nationalities in project-based learning, such as building Web sites together in teams, could enhance the learning environment. Perhaps both TAMU and UP instructors could incorporate project-based learning projects. Third, partnership leaders must choose course content where the cross-cultural aspects are of minimal relevance or are integral to the content. Like the previous example, developing a Web site in multi-cultural teams may provide a more level playing field. Fourth, representation form needs to be considered in relation to the use of visualizations to replace or supplement text. Visual resources, while becoming more widely used due to multimedia advances, are subject to potential cross-cultural misinterpretation. For instance, only the UP students had access to multimedia in developing their Web biographies; if all participants were able to be creative, the bios would seem less one-sided.

Conclusion

This investigation was based on TAMU students' conceptions of educational technology and their explanations for the failed partnership. The investigation led to the verification of two existing models that explicate key design and cross-cultural considerations for use in cross-classroom and international environments. The first model provides six design considerations: grading system, grouping, collaboration, relevance, learner control, and technological preparation (Cifuentes et al., 1997). The second model provides four cross-cultural considerations: communication and interaction; language; content; and representation form (Collis & Remmers, 1997). Determining the delicate balance between and among these factors, particularly in cross-cultural settings, will pave the way for identifying key pedagogical techniques in making meaning. This study demonstrates the power of networking learners from across the world to learn about and from the perspectives of each other. A TAMU student summed up the experience by acknowledging that "instructional technology is world-wide, not just here in America. We have become a global society and every country is facing similar technological issues" (T7s).

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Diagram Representation: A Comparison of Animated and Static Formats

Sara Jones
Cognitive and Computing Sciences
University of Sussex
UK
saraj@cogs.susx.ac.uk

Dr. Mike Scaife
Cognitive and Computing Sciences
University of Sussex
UK
mikesc@cogs.susx.ac.uk

Abstract: Multimedia enables novel ways of representing information, most strikingly as animations, but we lack good detailed accounts of its value for learning. The main study reported here investigates the value of animation for students aged thirteen and fourteen, learning the principles of cardiac circulation. The study compared the effects of media type, paper-based diagram versus computer-based animation, and of design of the learning task, structured versus open, in a 2 x 2 design. Learning was measured by completion of a diagram of blood flow through the heart. Statistical analysis showed a significant overall effect of task design but not of media type. Further analysis, however, showed that the animation produced distinctive kinds of errors and a second study looked in more detail at the effects of working with an animation. Results suggest it has the effect of making learners over-confident but can ultimately provide some benefits over static formats.

Introduction

The arrival of multimedia provides new ways of representing information through different media formats, such as, text, audio, graphics. Advances in technology have enabled diagrammatic representation in alternative forms, such as animation. Multimedia also provides the opportunity for innovative ways of interacting with information, not available with traditional media formats. A pervasive assumption is that the more complex and varied the technology the better the interaction and the better the learning. Large et. al. (1994) claims "It is frequently claimed by... producers (and emphasised by reviewers) that multimedia capabilities enhance educational value" (p.528). However, there is no body of empirical evidence that this assumption is generally valid.

Multimedia can be seen as a particular form of external representation, such as diagrams, which supports external cognition (Zhang and Norman 1994). Diagrams can be used to convey "whole processes and structures, often at great levels of complexity" (Winn 1987, p.153), and may reduce cognitive processing, as many important aspects for comprehension are perceptually available in the diagram and do not need to be worked out (Larkin and Simon 1987). Diagrams should, therefore, facilitate understanding, as information is more explicit and requires less inferencing. It has also been noted that different representational formats of the same structure "can activate completely different processes" (Zhang and Norman 1994 p.118). Different processes in turn may result in different conceptual understanding. Thus, the representational format may be critical in the way comprehension is actualised.

Advances in graphical technology provide the facility for dynamic processes to be represented in animated as well as static form, with the assumption that the ability of an animation to show motion more explicitly should be beneficial for learning. However, research investigating both animated and static diagrams, shows no comprehensive evidence of improved understanding, suggesting that provision of a moving image does not necessarily facilitate overall conceptual understanding. Several researchers have postulated the complexities of processing dynamic illustration and multimedia (e.g. Kaiser et. al. 1992, Hoogeveen 1997, Large et. al. 1994, Stenning 1998). This research suggests that animation may be problematic for comprehension for several reasons: use of animation on diagrams results in an unmanageable possible increase of perceptually available information, especially where multidimensional dynamics are involved (e.g. Kaiser et al 1992); use of multimedia representations can result in cognitive /memory overload due to too much information (Kaiser et.al. 1992), due to problems in having to integrate multiple representations not always simultaneously available on the screen (Rogers and Scaife 1997, Hoogeveen 1997). Interestingly, Kaiser et al. (1992) found that where only one dimension of the dynamic information was present then animation facilitated accurate observation. This suggests that 'parsing' of dynamic events is important in facilitating correct dynamical judgement.

To investigate the cognitive value of graphical representations this study uses the 'Cognitive Interactivity' framework developed by Scaife and Rogers (1996). This emphasises the interplay between internal and external representations on cognition (i) how new information is integrated with existing knowledge and re-represented and (ii) the identification of the cognitive benefits and costs of particular forms of representations identifying the properties of external representations in terms of their computational offloading - the ways in which different forms constrain the amount of cognitive effort required to solve informationally equivalent problems. An example is the way that different graphical forms of representations of the same information will limit the kind of inferences that are likely to be made, thus guiding thinking towards the concept to be acquired.

Study 1

The aim of this study was to investigate pupil learning from diagrams using either a static or animated format. Diagrammatic representation of blood flow through the heart was used in both CD ROM and paper format, to compare animated with static representation of the concept. As CD ROM presentation allows pupils more freedom in exploring information, whereas formal teaching situations use specific task questions, two different forms of task presentation were used. In the open task pupils were asked to use the diagram to find out: how the blood flows in through and out of the heart; about blood that is rich in oxygen, and blood that has less oxygen and about the different chambers of the heart, and structured. In the structured task pupils were given a worksheet with specific aspects for them to investigate designed collaboratively with a teacher. Thus, the effect of different formats of the same graphical representation and different task presentations on conceptual understanding of a dynamic process were investigated. Participants were taken from two community colleges and one comprehensive school in Sussex. No pupils had completed formal teaching on cardiac circulation.

Method

One hundred and twelve pupils aged thirteen and fourteen, from two Sussex community colleges participated in the study. Fifty three were male (mean age = 13 years 10 months; sd=3.2 months), and 59 were female (mean age = 13 years 11 months; sd=3.6 months). The independent variables were media format (CD ROM or static) and task type (open or structured). The dependent variable was the test score. A pilot study was undertaken to ensure that information was appropriate and to formulate task instructions and the test. In the main study half of the participants worked with information using the computer (animated) the other half worked with the paper (static) format. Half of each of these groups worked from the 'open' task, the other half used the structured worksheet. All participants worked for fifteen minutes on their allocated task, followed immediately by the test. Time allocation was decided as a combination of ensuring adequate time for collecting necessary information and restrictions from school curriculum activities. The teacher allocated pupils who worked well together into pairs.

Animated condition: The 'heart' section of 'What's the Secret?' CD ROM from 3M Learning Software was used. The programme covered varying aspects about the heart, including animated video presentation of blood flow. Information needed for overall understanding was found in separate parts of the programme. Pupils were guided to the relevant areas prior to beginning their own investigations, due to time restrictions, and pupils could ask for guidance during the task if they were unable to find the information they needed. Participants worked in pairs for fifteen minutes, prior to completing individual assessments.

Static condition: Three sequential static colour printed diagrams were taken from the heart section of 'What's the Secret' CD ROM. This design ensured coverage of information was apparently equivalent to the CD

IMAGE NOT AVAILABLE

Figure 1: Example of test diagram.

ROM information needed to complete the test. One class was given the 'open' task, the other used the structured worksheet. Participants worked with the information in pairs for fifteen minutes, prior to completing individual assessments.

Post test: This consisted of a black and white version of the diagram taken from the CD ROM. Pupils had to complete the diagram within five minutes, the task being to use arrows to show where the blood enters, flows through, and leaves the heart, using conventional colouration, a blue pen for deoxygenated blood and a red pen for oxygenated blood. Pupils were also required to put the following eight labels - 'to body', 'from body', 'to lungs', 'from lungs', 'right atrium', 'left atrium', 'right ventricle', 'left ventricle' - in the appropriate places (see fig1). Use of information and notes was not permitted for the test.

Results

Scoring Method

Four different aspects of the diagram, relating appropriately to the task and the structured work sheet, were chosen for analysis. One point was allocated for each of the following; (i) oxygenated and deoxygenated blood represented in separate sides of the heart; (ii) depicting different types of blood in the correct sides; (iii) correct labelling using all eight labels; (iv) correct depiction of direction of blood flow using arrows, or from labelling if arrows were not used. Subjects could therefore receive a score from 0 to 4. An interobserver reliability score of 95% was achieved.

The data were analysed to determine whether media presentation or task type affected learning about blood flow through the heart, and to determine the kinds of inferences made from the diagrams. The data are presented in three sections: analyses of the effects of both variables on the overall test score; analyses of the effects of variables on selected areas of the test from which scores were obtained; and analyses of errors made.

1. Analysis of both variables on the overall test score. A two way independent analysis of variance (ANOVA) was performed on the test scores. No significant main effect of media format was found. There was a significant main effect of task type ($F=5.08$; df =1,1; $p<0.02$), Scheffe ($p< 0.0215$); those using a structured worksheet performed significantly better than those using an open task, regardless of media presentation. No interaction was found between the two variables.

2. Analysis of the effects of variables on selected areas of the test A series of two-tailed chi-square analyses were performed separately on the four selected parts of the test to determine whether media presentation or task type affected performance in particular areas of the test. No significant differences were shown in any section: Blood in separate sides, chi-square 0.017, d.f = 1, not significant; Blood in correct sides, chi-square = 0.013, d.f = 1, not significant; Labels, chi-square = 0.505, d.f = 1, not significant; Directionality, chi-square = 0.108, d.f = 1, not significant.

3. Analysis of errors made. Despite the absence of overall significant differences, an inspection of individual scores showed that pupils made more errors with labelling and direction of blood flow. Analysis on these aspects revealed differences in errors of interpretation of blood flow. The two most noteworthy errors were; showing blood to flow into the heart deoxygenated but to flow out oxygenated or vice versa; and perceiving the blood to enter the heart through the ventricles and leave via the atria. A chi-square was performed to determine whether pupil interpretations were affected by the two independent variables, and was found to be significant for 'in deoxygenated/out oxygenated' (chi-square = 6.00; d.f = 1; Fisher exact $p<0.0222$), and approaching significance for 'blood entry through ventricles' (chi-square = 4.03; d.f = 1; Fisher exact $p<0.0608$).

Discussion

The results showed no significant difference in overall test performance between computer and paper diagrams. However, significant differences of task type were evident. As diagrams contain large amounts of information in one representation the learner must decide which aspects are important and in which order to 'read' information. Sequencing the information may reduce confusion and enable focus of attention on relevant aspects. The worksheet may have provided this by guiding pupils to specifically focus on smaller components of information and to order salient related pieces of information.

Although analysis of accurate depiction of each of the four chosen aspects showed no significant differences, pupils in all conditions made most errors with blood flow and labelling. This suggests that these concepts were less clear from the diagrams or were more conceptually complex to grasp. Analysis of these aspects in terms of errors made showed significant differences across conditions. Representation of blood flowing into the heart oxygenated and out deoxygenated, or vice versa was more prevalent in the animated condition. This seems to attribute to the heart a similar functional role as the lungs. Depiction of blood flowing in via the ventricles and out via the atria was predominant in the static condition.

These findings may be explained by aspects of graphical representation, in particular re-representation and computational offloading (Scaife and Rogers 1996). Re-representation: the results suggest that different representations not only influence whether problem solving is easier or more difficult, but also generate different understanding, confirming that different representational formats of a common structure "can activate completely different processes" (Zhang and Norman 1994, p.118). In this study the animated version shows simultaneous movement of all aspects of blood flow. Multidimensional dynamics are not sequenced into separate dynamical processes (as advocated by Kaiser et. al. 1992), and result in a confused presentation of movement. Thus, 'direction' could be misconstrued as blood flowing in one colour and out another colour, resulting in the confusion of oxygenated in, deoxygenated out. The static diagram did not explicitly show direction of blood flow, which had to be inferred from the labels (fig.1). Without attendance to these labels direction could also be misconstrued.

Computational offloading; overall, improved understanding of the circulation in the heart was not apparent from the use of animation, supporting evidence that multidimensional problems are not aided by animation (Kaiser et. al. 1992). Too much movement of different parts and different types of blood made it difficult to see where each element was going and what each part was doing. Pupils made comments such as 'stop moving' and used the diagram in stationary format to work out the blood flow. Although use of animation may be assumed to increase perceptually available information thus reducing cognitive processing, cognitive effort and 'working out' of dynamics may be reduced to such a degree that learning is ineffectual.

Although animation may be more explicit "our perceptual appreciations do not spontaneously form the basis of our conceptual understanding of dynamics" (Kaiser et. al. 1992, p.686). Anderson (1995) proposes that conceptual knowledge is based on the meaning of a representation. Errors in pupil learning suggest that comprehension of the function of the heart or reasoning behind the blood flow was lacking. This information was not explicit in the information in either presentation format, therefore the meaning of the representation was not evident. If 'meaning' is important in overall conceptual understanding then awareness of the rationale behind the concept may constrain certain aspects of the process. Knowing the function of the heart, or each part of the heart, would serve to constrain the inferences or information gleaned from the diagram. For example, if the function of the ventricles to 'pump' blood out of the heart is made explicit, then this constrains the way that the blood is likely to flow, consequently affecting diagram interpretation. The context and function of a represented structure may critically influence the effectiveness of a graphical representation. Not only may it be important to investigate the external graphical constraints (Scaife and Rogers 1996) of a representation, but also the internal cognitive constraints.

These aspects confirm cited complexities of animation and multimedia. Stenning (1998) suggests that such complexity may be a result of the following characteristics of animation; i) evanescence, the problem of memory load is enhanced by the 'transient form' of animation, which means that all sequences of movement need to be held in memory to integrate with new pieces of information to understand the process; ii) control, the evanescent form means that learners are unable reaccess pieces of information as they are no longer perceptually available. Learners therefore have no control over what information is viewed, or for how long, as information is continuously passing by. Large et al (1994) proposes that "animation improves performance when used as an interactive dynamic, continuously changing *depending on subject input*" (p. 527, emphasis added); iii) expressiveness; Animation demands a more expressive representation, as all aspects of a process must be shown simultaneously, making focus on one aspect difficult. So: how do pupils work with animated and static representations. Do these properties of animation complicate learning? Do static diagrams give clearer understanding?

Study 2

Study 1 demonstrated that different representational formats of the same process result in different understanding, and suggests that learning a dynamic concept is not necessarily facilitated by animation alone, comprehension being dependent on other factors. Study 2 set out to examine more specifically the differences in ways that pupils worked with animation and static diagrams of blood flow, which parts they found hard or easy to understand, and investigate cited claims about animation.

Method

Twenty two pupils aged 13 and 14 years (mean age = 14 years 1 month) participated in the study. Thirteen were male and nine female. This study used verbal protocols of pupils working in pairs (as allocated by the teacher) either with a computer presented animated diagram or with a static paper diagram. All participants worked with the researcher for approximately half an hour on their allocated information, but those using the static diagram were also given an opportunity to briefly work with the animated version, to investigate any further information. All sessions with pupils were video-recorded.

Animated condition: The same CD ROM programme was used as in study 1, but pupils worked only with the animated diagram. Text information was obscured and introduced only if pupils found it too difficult to retrieve information from the diagram alone. Pupils interacted with the programme only by clicking to view the animation again.

Static paper condition: This consisted of a single diagram from study 1, initially without accompanying text. Pupils were provided with pens to make notes on the information if they chose. One of each pair was given a few minutes to study the diagram alone. Time allowed was dependent on the individual pupil, but generally did not exceed five minutes. Pupil 1 was then required to explain to pupil 2 what the diagram was showing. The interview proceeded differently with each pair according to the information relayed back from the pupils. Pupils participated in discussions between themselves. The researcher intervened only when pupils were unable to glean any more information, by asking open questions or more specific questions depending on pupil progress.

Results and Discussion

Preliminary analysis confirms previous caution that animation, can be, as in this case, too complex - being too fast, lacking in learner control, and impeding attention focus, and suggests that animation alone may be insufficient to aid comprehensive learning of a dynamic process. Animation appeared to generate artificially high confidence levels, increasing complexity and preventing learners from paying appropriate attention to the information. For example, children refused the opportunity to view the animation more than once despite evidence of miscomprehension. This suggests that animation provides inappropriate computational offloading precluding the possibility of effective learning, by giving the learner false certainty of gained knowledge. Only when learners had to explain the process or were asked specific questions, were they aware of their lack of understanding. Externalisation of knowledge may be an important part of the learning process (Chi 1998), with diagrammatic learning as well as textual. Only one pupil was able to give a full description of blood flow after initial viewing. Two pairs made inaccurate interpretations of flow, perceiving blood flowing in one colour but flowing out the other. This suggests that they perceived oxygen exchange taking place inside the heart. Moreover, these pupils stated that the function of the heart was to 'clean the blood' i.e. to oxygenate the blood. This equates with errors found in study 1, also suggesting that meaning and interpretation of a representation may be related.

Inability to focus attention was apparent when pupils were asked questions about specific aspects. For example, all pupils primarily focused on blood flow. After one more viewing four of the pairs noticed the heart contracting. No pupils spontaneously noticed valve action and had to be specifically directed to this component. Even then three pairs needed to watch the animation twice more to procure appropriate information. Pupils themselves expressed difficulty with focusing, suggesting that directing attention to pertinent pieces of information is important. With each viewing of the animation pupils were able to explain blood flow in more detail, and combine this information with contraction and valve action. Thus, they appear to take in small amounts of information at one time, gradually combining their knowledge with previous pieces of information, which highlights the importance of parsing or sequencing knowledge acquisition.

Despite some disadvantages, animation may provide benefits over use of static diagrams alone. When attention was focused and pupils were directed, animation imparted more information about the dynamics of the system than pupils could obtain from a static diagram, for example, they could construct clearer models about how the valves worked and how the heart 'pumped'. However, in both of these studies interaction with information was severely limited. Future research is continuing to investigate the effects of different levels of interaction with such diagrams on learning, for example, slowing down the animation, stopping facilities, focusing attention on salient aspects of information in an appropriate order, the effect of construction and simulation on comprehension of such a system. This research will also investigate pertinent aspects of learning, such as the effects of externalisation by interacting with information.

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Desktop Videoconferencing as a Basis for Computer Supported Collaborative Learning in K-12 Classrooms

R. T. Jim Eales
Dept. of Computing & Information Systems
University of Luton
Park Square, Luton, LU1 3JU, UK
jim.eales@luton.ac.uk

Dennis C. Neale[1], & John M. Carroll[2]
[1]Dept. of Industrial and Systems Engineering & [2]Dept. of Computer Science
Virginia Tech
Blacksburg, VA24061 USA
dneale@vt.edu, carroll@cs.vt.edu

Abstract: In this paper, we describe our efforts to introduce desktop videoconferencing into schools. Our particular project focus is the support of distributed collaborative learning between K-12 science classrooms. We outline an educational argument for the use of videoconferencing and go on to present a case study of the educational videoconferencing experiences in our project. We particularly identify and describe the kinds of technical difficulties that can be encountered and the way we overcame most of these problems. Once the students began to use the technology meaningfully to support inter-school collaborative learning a whole host of interesting educational, organizational and other issues began to emerge. We highlight the most important of these issues. Finally, we consider some of the issues influencing teacher acceptance of videoconferencing.

Introductio

We consider K-12 education to be an important but largely unexplored area for the application of collaborative technology. Videoconferencing has been around for over three decades but in that time it has enjoyed little commercial success or widespread acceptance. In this paper, we report on our efforts to introduce low-cost Internet-based desktop videoconferencing (DVC) into K-12 science classrooms as a basis for Computer Supported Collaborative Learning (CSCL). Desktop videoconferencing does *not* use specially equipped rooms or studios to facilitate telelectures; it uses the desktop personal computer as the basis for synchronous multimedia communication with remote others. There has been little published research into the introduction, use, and acceptance of DVC to support distributed collaborative learning in and between K-12 classrooms. Most research in the general area of educational videoconferencing has concentrated on distance education (usually at university level). We make a clear distinction between CSCL and distance education. Whereas, CSCL emphasizes supporting peer interaction, distance education is more concerned with supporting instructor-student interaction. CSCL is a relatively new area, and those working in this area are still involved in the process of defining its boundaries (Bannon 1995). It includes collaborative learning *through* a computer, *around* a computer, and even *with* a computer. Our project focus, and the focus of this paper, is on collaborative learning through networked-computers, but because most classroom computers have multiple users, there is usually also an element of collaboration around a computer involved.

The Educational Value of Videoconferencing

We believe there are sound educational reasons for incorporating desktop videoconferencing into everyday classroom activities. Over the last decade or so, there has been a growing awareness of the link between learning and context. Learning is now widely seen as inherently social and taking place within a community of learners (Brown & Campione 1996). Individual cognitive development is largely shaped and determined by the characteristics and potential of the various communities of which one is a member and by the role or identity one assumes within these communities. Unfortunately, the kinds of mental activities encouraged, developed, and valued in school communities appear to be quite different from those valued outside of school (Resnick 1987). If we consider schools as communities of practice, the primary practice appears to be schooling (i.e. activities and skills that only have meaning within schools). Cognition outside of schools is typically socially distributed, linked closely to tool manipulation, situation specific, and involves contextualized reasoning or reflection in action. In contrast, school-developed knowledge and skills are rarely capable of being meaningfully applied in other contexts. In other words, school learning is often inauthentic.

Communication technology and associated activities afford the opportunity to "virtually" extend school-based communities of learning (Eales & Byrd 1997). Authentic activities are often collaborative and children benefit when their learning involves meaningful interaction with their peers. Learning can also be enhanced when children engage in learning activities with students of other ages. With younger children, they reinforce their own learning through having to articulate and demonstrate their knowledge, while with older children, they receive assistance from a more advanced learner's perspective. School-based educational activities can also be stimulated and enhanced by contact with domain experts from outside the school system, for example, scientists, mathematicians, or writers. These representatives of real-world communities of practice not only provide expert advice, they also act as role models and guides. Generally, "outsiders", experts, local community members, or parents can be a source of authentic influence on school practices, which can help to develop more meaningful and robust cognitive abilities among students.

Various technologies, such as the World Wide Web, e-mail, and interactive chat can contribute to extending learning communities. But videoconferencing, particularly in its support of social presence (Short et al 1976) and mutual knowledge (Krauss & Fussell 1990), may be a uniquely suited technology for extending the learning boundaries of the classroom. Daly-Jones et al. (1998) found that when more than one person is at each end of a conference, video makes a significant difference to the fluency of interaction and awareness of remote partners. However, the effective use of videoconferencing in authentic collaborative learning situations still remains a largely unexplored area. Our project seeks to contribute to the development of understanding in this area.

Early Experiences with Videoconferencing

The context for our investigation is a large interdisciplinary project group from Virginia Tech and the Montgomery County Public Schools (Virginia) supported by a major award from the U. S. National Science Foundation. The *Learning in Networked Communities* (LiNC) project seeks to leverage the network infrastructure brought to the County by the *Blacksburg Electronic Village* (BEV) (Carroll & Rosson 1996). A recent report (Elswick 1998) describes Blacksburg as "America's most wired town", with 60% of residents and 70% of businesses currently on-line. As part of the infrastructure support for the BEV, all the schools in the county are connected to the Internet by T1 ethernet lines (capable of transmitting data at around 1.5 million bps).

Our particular interest is the development of network support for middle and high school science education with a special emphasis on collaborative learning. Apart from our interest in educational videoconferencing we have also undertaken extensive research into the participatory design of educational software and the development of Java-based tools for collaborative learning. The project members include four science teachers from four different schools, two high schools and two middle schools. One of the high schools and one of the middle schools are together on the same campus in a rural part of the county. The other two schools are in the Town of Blacksburg and are approximately one mile (1.6 km) apart. The distance between the rural and the town schools is approximately 12 miles (19 km). DVC has been used to support a variety of different interactions, including *peer interactions* between students at different middle schools, *cross-age interactions* between middle school students and high or elementary school students, and *expert or mentor interactions* between middle school students and non-teacher adult mentors.

Our videoconferencing experiences in the LiNC project can be divided into two quite clearly defined phases. Our early experiences (phase 1), although they demonstrated a potential interest from teachers and students were dogged by technical problems. Our later experiences (phase 2) have demonstrated that most of the technical problems can be solved allowing us to begin to study the educational, organizational and other implications of videoconferencing in the classroom.

Our early experiences using videoconferencing in the classroom demonstrated the potential of the technology but also highlighted a number of significant problems. On the one hand, students were highly motivated towards videoconferencing and the teachers felt that it was a positive educational experience, while on the other hand, technical problems abounded and clearly interfered with the quality of the educational experience. These conflicting reactions are summed up by the comments from one middle school student:

> "Videoconferencing is a lot of fun. It's almost like sitting in the same room with the person that you're talking to. But I do think that it could be better. Not only the computer, but things like volume or the background noise, the speed at which the sight and sound come, and the amount of time we were on the computer."

Reliability Problems - Our early videoconferencing sessions between students at different schools often involved a number of system crashes. We had tested the hardware, software, and educational activities beforehand in the classrooms, but a condition that only occurred during actual school classes caused the computers to crash. After every crash, the computers would have to be "hard-rebooted", that is, turned off and then turned on again. Quite apart from the obvious loss of time (around 5 minutes) involved in every crash and reconnection, such incidents severely disrupted the flow of communication and concentration of the students. On this particular system, the first indication of an impending crash was the freezing of the received video image, the audio connection would be lost a short time afterwards. This allowed just enough time for the students to transmit a distress message usually along the lines of "your faces are frozen". Not surprisingly the students' reactions to system breakdowns were disappointment and disillusionment. During one of the breaks in communication caused by a crash, one high school student said to another, *"I think it would be easier to go over there in person."*

Audio Problems - Audio quality was a constant problem. Quality was variable but usually poor. Sometimes a system crash resulted in better audio quality when reconnection was achieved. The particular videoconferencing system we were using lacked any way of adjusting the audio levels. Getting closer to the speakers and microphone (as well as shouting) became the only method of varying the levels of sent or received audio. Audio levels were such a constant problem that many of the groups assigned a "designated listener" to press their ear against one of the computer speakers and then relay the incoming audio to the other students in the group. Another response to poor audio quality was to move communication to the chat (text) channel. Unfortunately, classrooms appear to be inherently noisy places often with poor acoustic properties. Unlike audio quality, the quality of the video did not seem to be an important issue for the students.

The "Do You See What I See" (DYSWIS) Problem - Activities between students using videoconferencing often involve coordinated use of applications running on the two computers. In the particular system we were using there was no way for one group of students to see or control what was on the other group's computer screen. This leads to a common situation where one group has to describe to the other group just what they should have on their screen. In reply the other group then has to try to describe what they actually have on their screen. Students were often not familiar with the names of programs or the terms for screen features (e.g., icon, dialog box). In such circumstances a common reaction is to pick up the camera and point it at the screen.

Camera Framing Problems - The standard desktop videoconference cameras are naturally built for office use. If a camera is placed on the top of the computer monitor, it captures the image of a seated user quite well. However, in the classroom, computers often have two, three, or more users. Students, either by design or accident, start to disappear from the transmitted video image as the communication session progresses. Sometimes, all that can be seen of a group of students is perhaps an ear and an elbow.

Overcoming the Technical Problems

Our early experiences using desktop videoconferencing in the classroom were often depressing and frustrating for students, teachers, and researchers alike. Clearly, without project motivation there was little likelihood of the teachers incorporating videoconferencing into their normal educational practices. However, these early experiences did allow us to clearly identify the principal practical problems related to using this technology in classrooms. Before we began the second phase of videoconferencing we tested a number of different videoconferencing programs, cameras, video capture cards, and microphones in different settings. Each of the four classrooms in the project is now equipped with 5 computers (200Mhz Pentium PC's). Three of the computers in each classroom are equipped for desktop videoconferencing. This involves the fitting of a video capture card and the provision of a camera, a microphone, and videoconferencing software (Microsoft NetMeeting 2.1). We also have computers at the university equipped for videoconferencing. These can be used for communication between experts or mentors at the university and the classrooms, or for project personnel to communicate with teachers. Most of our videoconferencing has been point-to-point, but we are currently experimenting with multi-point conferences in some instances.

The audio quality and audio control in our second phase DVC system has been extremely good. However, classrooms can still be noisy places and background noise is still a problem. To address this problem we have provided inexpensive unidirectional microphones with a very short effective pick-up range. The disadvantages of these microphones are that they have to be held in the hand close to the mouth. This reduces the ability for someone using the microphone to control the computer with two hands. It also means that whoever holds the microphone can monopolize the communication. On the other hand these small inexpensive microphones are remarkably effective at cutting out background noise.

The "Do You See What I See" problem has also been solved by the DVC software we are now using. Students can now share any application with other students, for example, show them web pages or word processing documents. Students can also collaborate while using an application, which means that control can pass back and forth between the collaborating parties. Students also use the collaborative whiteboard and text chat, and pass information between schools by point-to-point file transfer.

The only technical problem that still remains an issue is camera framing. While most of the groups have 3 or 4 members the number of students appearing in the video window is typically around 1.25. Ideally we would like a wide-angle camera that can still sit on the top of the monitor (the only logical place to position the camera). We have experimented with the use of the video image from our wide-angle video cameras used for data capture as feed into the DVC transmitted video image. This tends not to provide very much detail and can not of course be considered a permanent solution. We continue to experiment with different cameras and camera positions in an attempt to improve this situation. We have also experimented with a hand-held camera for close-ups of student models and other physical objects. This involves an additional camera on a long cable connected to the computer via a switch-box, allowing students to switch between the monitor-mounted camera and the hand-held camera.

Computer systems used in schools have to be more than just reliable; they need to be robust to withstand intentional and unintentional misuse by students. The revised hardware-software combination used for videoconferencing in phase 2 of the LiNC project has proved to be remarkably reliable and robust and has solved most of the previous technical problems. System crashes are now extremely rare. Students now quite happily use DVC with little support or intervention from project personnel, and confidence in DVC technology has even developed among the teachers again.

Beyond the Technical Problems

Our initial phase 1 videoconferencing experiences in the project forced us to focus on the various technical problems. In phase 2 of the project the technology has now become largely transparent for the students allowing them to concentrate on their education activities. Below a certain technical threshold the student discourse appeared to be mainly concerned with the technology itself, but above this threshold users concentrated on the tasks in hand. The significant reduction in technical problems has allowed us to begin to focus on the many interesting educational, organizational and other issues now emerging from the project. We highlight some of the most immediately apparent issues in this section.

Around the same time that we changed the videoconferencing technology, the teachers involved in the project initiated a change in educational direction. Previously, our use of technology in the classroom had primarily focused on one-off "experimental" situations occurring every few months. The teachers felt that an ongoing collaborative project-based approach would provide a more meaningful basis for considering the introduction of videoconferencing and other network-based tools into the classrooms.

Educational Issues

Student motivation is an important factor in education. Most students involved in our project show a considerable interest in videoconferencing in the classroom. However, some students show an active interest in videoconferencing (they want to start communicating as soon as possible) whereas other students are only passively interested (they like to observe but not take part in the interaction).

Perhaps the most significant educational issue to emerge from our introduction of DVC into the classroom was that many of the most active and competent DVC users were what might be termed "average" students. The experienced teachers in the project first highlighted this characteristic of videoconferencing. These students are often hampered in school activities by poor literacy skills. For example, one middle school student when asked which method of communication he preferred replied: *"The video [DVC], because you actually get a chance to see and talk to the person rather than spending a lot of time typing."* Videoconferencing introduces a new form of communication into the classroom which requires new skills. Many of those that demonstrated competency in this area were students who normally do not get the opportunity to excel in the classroom. Student motivation developed during videoconferencing also appeared to be transferred to areas where literacy skills are more central. For example, students coordinated videoconferencing sessions via e-mail messages and presented their final project reports in the form of web pages.

Not all students are comfortable with videoconferencing. Most of our videoconferencing sessions involved middle school students. These students are around 13 years old and this can be a difficult time, particularly with regard to concerns about self-image. One feels that, ideally, many students would like to be able to see and hear the students at the other end of the connection without being seen or heard themselves. We observed one particular videoconferencing session between two middle school groups where self-consciousness was very much in evidence. This was the first time this group had experienced videoconferencing. In a session that lasted approximately 20 minutes, the monitor-mounted camera was moved 19 times by the students. The camera view was usually moved away from the person doing the moving. Students also made comments, such as "get the camera away from me". Students in this group also showed audio self-consciousness. The microphone changed hands at least 27 times during this session. It was also offered to other students on many more occasions but refused. Side comments during the session included: "What? Someone else speak to them", "I don't understand Southern accents", and "I don't want it [the microphone] give it to her". In addition, we also observed many examples of nervous behavior, including adjusting hair, covering the mouth, and giggling. On other occasions we have observed videoconferences where students move communication to the text chat channel apparently to deliberately avoid talking into the microphone. One of the most common ways that groups seem to deal with this self consciousness issue is to designate one student to act as spokesperson for the group. The whole issue of student attraction and fear towards videoconferencing needs further investigation.

Organizational Issues

We have found that the educational value of videoconferencing is highly dependent on the suitability of the collaborators and the underlying basis for the collaboration. You cannot just connect people together and expect them to meaningfully collaborate. One of our student projects involved a group of students at one school building the arm of a working robot and another group at a different school building the mobile base. Clearly such an activity requires that the two groups actively collaborate. The development of such *collaboration-dependent activities* can have a positive influence on the perceived educational value of DVC.

Three obvious coordination problems are immediately apparent:

1. Teachers need to establish contact with remote others (teachers or experts) who can organize/provide meaningful educational interactions for their students. These contacts not only have to be educationally compatible, they also need compatible videoconferencing facilities.
2. Assuming teachers have been able to make contact with suitable others, they then have to negotiate a basis or a context for the use of videoconferencing in their respective educational practices. This is no simple process. Teachers, even those teaching the same subject to the same age students, have very different teaching styles and related practices.
3. Time is very important in middle and high schools. Classes change according to the clock. We have found that even in the same county, schools may have different time slots for the classes throughout the day. Trying to organize a time when groups from two different locations can take part in synchronous communication can be extremely difficult.

In the LiNC project, these coordination issues have been less apparent because the project itself has provided a basis and a structure for coordination between the various teachers.

Does DVC have a Future in K-12 Education?

We see desktop videoconferencing as a valuable educational tool particularly suitable for supporting distributed collaborative learning between schools and between schools and the community. However, teachers have a considerable amount of autonomy in their own classrooms and any kind of significant educational reform, including the widespread acceptance of new technology, is notoriously difficult. Our studies suggest that desktop videoconferencing supports distributed collaborative learning surprisingly well. Even though the technology was presumably developed with office environments in mind. However, the suitability of the technology and the high motivation levels amongst students does not guarantee that DVC will be widely accepted in schools. We have described the possible technical problems in some detail and have gone on to suggest some of the organizational issues that also need to be surmounted. Our experiences suggest that desktop videoconferencing can make a significant and special contribution to learning in schools, however, there are many factors that may hinder the widespread acceptance of this technology.

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Customizing the Web

Two Tools for Individual and Collaborative Use of Hypermedia Course Material

Thorsten Hampel, Harald Selke
Heinz Nixdorf Institute
Paderborn University, Fürstenallee 11, D-33102 Paderborn, Germany
E-Mail: {hampel | hase}@uni-paderborn.de

Abstract: It seems desirable that learners do not only passively browse through course material, but are also able to actively work with it by adding own material, annotating existing documents, creating own views of the material and exchanging documents with fellow learners. We have developed two tools that allow for such active individual and collaborative use of course material. "Semantic Spaces" allow learners to organize hypermedia documents according to their individual view while not interfering with the "real" link structure of the course material. These spaces are represented as maps and serve for orientation as well as navigation purposes. A collaborative virtual environment has been developed to allow for synchronous as well as asynchronous multi-user collaboration. Both concepts have been implemented and tested as prototypes that can be easily integrated into standard or advanced web technology. An evaluation will yield first results by the beginning of 1999.

1 Introduction

The World Wide Web has become one of the major ways to distribute course material to students. However, this material is usually only available for browsing purposes. While the original idea of hypertext allowed readers to take an active role in the creation and extension of hypertext documents (cf. Bush 1945, Nelson 1980), the World Wide Web has ignored this concept. Material presented on standard web servers is usually static in the sense that readers cannot actively work with it: Because links are embedded into the documents and are always visible to everybody, readers are not allowed to link from existing documents to material that they feel is important for the learning context, nor can they annotate existing documents. Also, restructuring of existing material is only possible in very simple ways (by bookmarking) or by writing own documents that are external to the server. While with advanced technologies like, e.g., Hyperwave (cf. Maurer 1996) some of these restrictions have been removed, the problem of allowing the learner to create their own view to existing material has not been solved.

We believe this problem to be closely related to navigation and orientation problems in hypertexts that have often been reported (see, e.g., Conklin 1987) and are of particular importance in learning contexts where learners have to construct knowledge from large bodies of material presented to them. Semantic Spaces allow users to create their own maps of the hypermedia material, thus documenting their individual understanding of the information space. Objects recorded on the map can be connected to the "real" objects of the hypermedia system. When users move through the material, their current position can be visualized in the Semantic Space. First experiments with mock-ups suggest that users get a better overview of the hypermedia material and have a better sense of orientation. A tool that allows creating, modifying and sharing of Semantic Spaces has been implemented as a prototype and is currently being tested. An evaluation and further developments are planned for 1999.

While this tool may help learners to work with hypermedia course material individually, collaboration between fellow learners is one major aspect in teaching and learning processes. When learning with hypermedia systems in a collaborative environment, students need to communicate their position and their understanding of the documents to each others in order to start a dialogue about the material provided by the system. Thus, learners should be supported in sharing perspectives on course material (cf. Wan & Johnson 1994). Norman (Norman 1994) reports that special tools are needed for communicating the current position and knowledge of the structure of the material used: "Pointing out" the user's current position or sharing their knowledge with other people is impossible without shared knowledge of the structure of the system. In the project sTEAM, we have developed such a tool as a client-server application that is based on a MUD (multi-user dungeon) environment. Learners may meet in "rooms" within that system and share documents as well as discuss topics, thereby implementing asynchronous as well as synchronous cooperation facilities. A prototype is currently being evaluated.

In the next section we will shortly discuss the possibilities and problems of creating individual views on course material and cooperating with fellow learners when working with standard tools. We will also discuss features of more advanced learning environments. The following two sections will then describe the two approaches of individualization and cooperation of web based material and compare them to related work. The prototypes will be described. The last section will summarize the main results and describe the plans for further development and evaluation of the tools.

2 Working actively and collaboratively with documents

Many hypermedia systems under development today are used in education. The most promising aspects of hypermedia use are in our opinion (Keil-Slawik, Klemme & Selke 1996):

- the integration of all materials used in the learning process;
- the availability of these materials for all forms and phases of learning, without the need to use different media in different situations;
- hypermedia's capability of being a repository for all learning situations, with the option of reusing hypermedia units in different situations and contexts.

Hypermedia systems for this purpose need to accommodate large and frequently changing bodies of documents. This requires powerful tools allowing users to move through the hypermedia system, interact with it and other users, and customize it for their personal needs.

While today we see more and more courses offering material via the World Wide Web, it was already in 1993 that Ben Shneiderman coined the phrase of "education by engagement and construction" (Shneiderman 1993). He stressed the fact, that students on the one hand have to interact with the material—which means not just clicking and hopping from page to another—and on the other hand need to interact with each others. Also, in the development of the Intermedia system the developers state that "hypertext systems that support multiple users allow researchers, professors, and students to communicate and collaborate with one another within the context of a body of scholarly material" (Yankelovich et al. 1988, p. 81). This is definitely a potential of hypermedia systems, the importance of which is obvious from a constructivist viewpoint. However, we find little of that in the courses we nowadays see on the web.

This is mainly due to the fact that the World Wide Web in fact is mainly used for the mere distribution of documents. Because of the Web's and HTML's architecture, the material can only be read. Students are not able to create personal hyperlinks or organize the documents in an individual manner apart from setting bookmarks, a technique that—according to questionnaires to our students—is heavily used by learners. For security reasons, many universities do not even allow students to publish their own documents on the faculty's web server. Annotations to documents were possible with Mosaic, a browser popular in the old days of the web. However, users could only create annotations on a per-document basis in an additional file. With the Netscape and Microsoft browsers becoming more prominent, the situation became even worse since these browsers do not support annotations at all. As a consequence, the Web often serves as a printing-on-demand device for text documents. Cooperation is also only possible in a very limited way: by sending documents or links to other users.

These limited capabilities suggest the use of more advanced web servers like, e.g., Hyperwave (see Maurer 1996) that allow users to actively work with documents (cf. Brennecke, Schwolle & Selke 1997). As compared to traditional Web servers, Hyperwave offers several important advantages. The sophisticated user management and integrated management of access rights makes it possible to establish a private area for each student where they can file their own documents and create a personal view of the available documents. With Hyperwave's concept of collections different views can be created without installing real copies of documents. In combination with the integrated link management, links always point to the most recent version of a document even when the material has been revised. However, these views are still more or less lists of links. A graphical representation of the document set can either be produced with a "local map" of links (see next section) or hand-crafted clickable images that are difficult to maintain.

Hyperwave also offers limited cooperation functionality through access rights. Users can decide who is granted read or write access to their documents. Other systems coming from the CSCW area, such as Lotus Notes, offer sophisticated workflow mechanisms. However, collaboration in learning contexts is usually very different from cooperative processes in a company, as both, the formation of groups of learners and the collaboration based on documents, are rather informal. Also, groups only exist for a very short period of time and members may join or leave within very short time intervals. For this reason, the systems mentioned so far are only of limited use in collaborative learning environments. In the web, there is no relation between the documents and the people working with them: E.g., it is not possible to obtain any information about people who have read a particular document.

3 Individualization of course material: Semantic Spaces

It has been claimed that link structures in hypermedia systems map well onto users' cognitive structures (Jonassen 1986). However, this hypothesis is questioned by many experts in the field (see, e.g., Duffy & Knuth 1990). The link structure itself is based on the syntactic structure, i.e. the interrelationships defined on the document space by hyperlinks. This must not be confused with the semantic structure of the contents of hypermedia documents, i.e. the interrelationships of the concepts presented, since these are in most cases not the same (Whalley 1990, p. 63).

The insight into these structures is particular to a user and cannot easily be transferred to others. Specifically non-experts need help finding out about the concepts covered in the documents and they are not necessarily interested in the form of presentation as represented in the link structure. In particular, users new to a subject have problems discovering the underlying structures and finding their way through the material. Understanding of a subject area develops gradually. Users continuously extend their models as they find more information. These models are different from the relationships explicated by nodes and links in the hypermedia material, so the students' model can be completely wrong and will (hopefully) be corrected later.

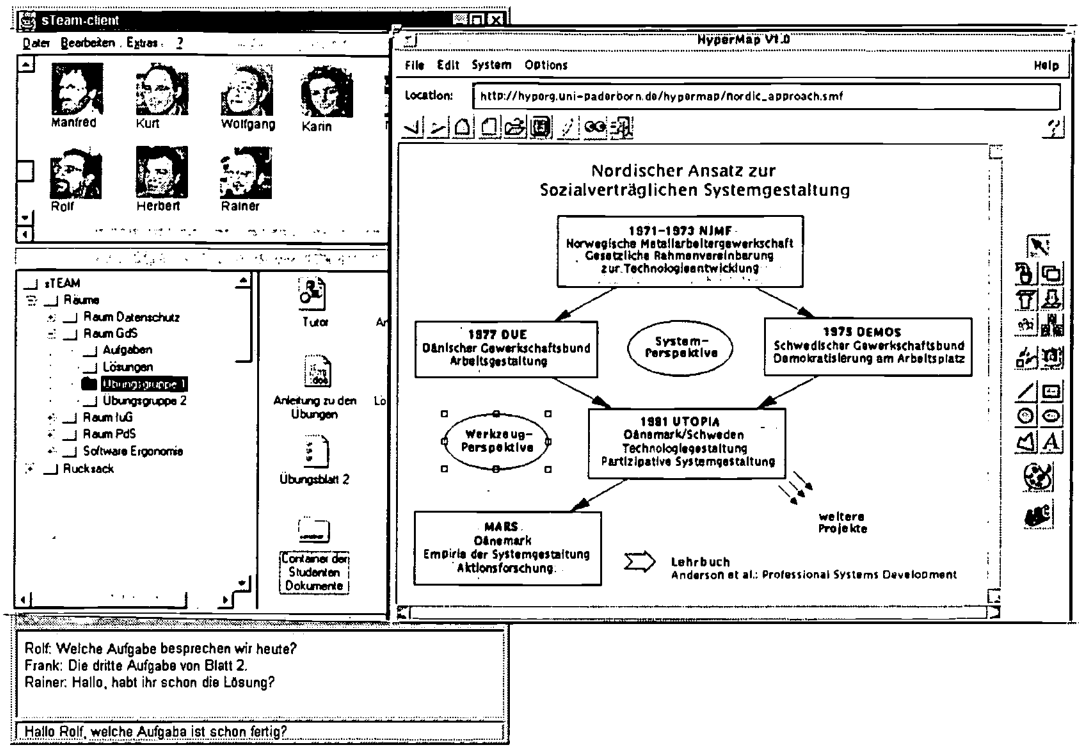
These problems of individualization and orientation are amplified in large interwoven hypermedia systems such as the World Wide Web, which span huge numbers of hosts and reference material of different contexts. In order to make efficient use of a hypermedia system, a consistent hypermedia working environment needs to be provided to the learners. It should offer tools for information selection, navigation through the system, and documenting the findings and results. Utting and Yankelovich (Utting & Yankelovich 1989) described and tested different tools such as local and global maps for solving navigational problems. However, the proposed tools proved either to be insufficient in scope or too complex to be understood and efficiently handled by the users.

Semantic Spaces may help to overcome these problems. A Semantic Space is a two- or three-dimensional map that represents the user's individual understanding of the information space. It is closely intertwined with the objects of the hypermedia systems and serves as a tool for the active exploration of hypermedia systems. As users move through the hypermedia system, they enter concepts and relationships that they think are significant into the map. The concepts displayed in a Semantic Space are thus not necessarily related to the nodes and links in the hypertext, but represent the user's current knowledge and understanding of the system. Users can therefore explicitly document their personal understanding of the part of the system they have explored.

Items and links in the Semantic Space can be created interactively by naming the concept and target document or by dragging a document icon into the map, automatically connecting the object in the Semantic Space with the documents. The interrelationships between the concepts in the Semantic Space and the documents of the "real" hypermedia system are maintained by specially labelled bi-directional hyperlinks connecting concept and document. With the help of these links, the position of the user within the hypermedia system can be visualised in the current Semantic Space when the user moves through the hypermedia system. They will be altered, moved or deleted as the process of understanding continues. A set of tools, similar to those of standard desktop environments, for grouping, moving, deleting, etc. provide for quick and direct manipulation. Additional drawing and writing tools allow for annotation and graphical markup (arrows, boxes, etc.).

By creating maps of their own, users can develop and visualize a spatial understanding of the hypermedia system. This intensifies the users' involvement and can thus foster their understanding of the overall context (Shneiderman 1993). The general layout of the map remains persistent until the users decide to change it because it no longer represents their understanding of the document space. The maps themselves are also documents within the hypermedia system. They can be inter-linked with the other documents or be referenced by other Semantic Spaces, thus creating a mesh or, if required, hierarchy of maps. Since they are persistent over time and can be shared with other users, they can be used in group learning situations to assemble and document the group's common knowledge of the information space. Furthermore, they can provide starting points for the further exploration of the system. Collaborative design of Semantic Spaces may thus foster understanding and learning in groups.

A tool for the creation and usage of Semantic Spaces has been implemented on top of the hypermedia system Hyperwave using a combination of Java and JavaScript. Users can use their standard Netscape browser to retrieve



documents from the hypermedia system. A separate map viewer communicates with the Navigator windows indicating changes in location. By selecting an element in a map the user may also cause the browser to display the corresponding document.

The concept of Semantic Spaces is described in more detail in (Klemme, Kuhnert & Selke 1998). In supporting constructive navigation in hypermedia systems, they are similar to the NESTOR system (Zeiliger 1998). Whereas in NESTOR there is an automatic generation based on the user's activities, in Semantic Spaces the users explicitly have to create their own visualization. Evaluations may show if there are significant advantages in either of the approaches. Semantic Spaces may also be compared to concept maps (Kremer 1997). However, they do not impose any rules on how to represent objects and relationships. Also, while providing an abstraction from the underlying hypermedia database, Semantic Spaces still serve as navigational and orientational means by providing location feedback.

4 Collaborative Virtual Environments: sTEAM

With the emergence of local area networks and the massive growth of the Internet, communication games on these networks, the so-called MUDs (multi user dungeons), were developed. While many of these are text-oriented, recent games of this type also support graphical user interfaces. MUDs are based on real-time communication and interaction of multiple users moving through a "virtual world" which is organized in "rooms" or "places". MUDs are based on a client-server architecture, allowing players with different computer systems to participate in these games from different places. MUDs are on the one hand multi-user capable, on the other hand authorised players, the so-called wizards, can restrict access to the game. They can grant or deny access to specific rooms to a certain group of players and can also extend the "world". In such games direct communication and interaction in real time are the main goals. Groups of players can communicate directly and influence each others in their game actions, while the communication flow is unrestricted. Since the architecture of MUDs is open, the games can be modified and adapted to new situations during the current session even while the system is running. So at any time during the game new situations can be created, with which the groups of players have to cope. A number of "serious" applications—usually called "collaborative virtual environments" (CVE)—have been developed on top of this architecture (see, e.g., Donath 1995).

Our goal was to combine the advantages of classical MUDs and Hypermedia database systems with each others, allowing users to share documents in a virtual world and to communicate with other users while working with certain documents (see Bollmeyer 1997). The system developed is called sTEAM and uses the paradigm of virtual rooms representing a document space. People can meet in virtual rooms, interchange documents and communicate with each others. The rooms can be seen as areas of interest or as given topics of a lecture. In these areas the stored objects are files, which all have some topic or subject in common. Exits connecting different rooms represent hyperlinks. The big advantage of this connecting technique is that they represent a semantic context without having to represent a planar layout of rooms that can be represented by a planar map.

Among the system's major new aspects are its abilities for easily constructing new rooms. As virtual rooms can be created by any user on-the-fly, document collections can be structured easily and personally or collaboratively by the students. For example, when students discuss different approaches to a certain topic during a tutorial or lecture on, say, user interface design, they can create a new room and meet there. They may then search for examples of different user interfaces on the web and collect these (as hyperlinks or as copies of the documents) in this new room. After they finished their work they could either leave this room and make it accessible for other students interested in the same topic, or take just a few objects to their private rooms and delete this temporarily needed room again.

Groups of students and teachers can thus build their individual and cooperative learning spaces. Hypermedia documents can be transported easily between the various rooms. Messages and attachments can readily be stored in such learning places and, most important, the learners may meet in groups within the system. The system may either be used within a scenario where students meet "in real life", using the rooms in the way described, or within a scenario where students do not meet and make use of the integrated facilities enabling them to synchronously communicate with each others. Currently, only a text-based chat tool is integrated, but audio or video connections may be implemented in the future. Thus, collaboration is enhanced through a powerful CSCW system regardless of whether people meet in the same place or work from different places.

The sTEAM system currently exists as a prototype consisting of a client written in Java and a web server implemented in the MUDs own object-oriented programming-language LPC using the Dworkins Generic Driver (DGD), a modified well-known MUD server. This system allows runtime modifications of all objects in the environment. To create their individual environment inside sTEAM, the user can employ the pre-defined objects, derive their own objects from existing ones, or create new ones by implementing them in LPC. Many different new objects may be created during a long term use of the system.

All sTEAM objects are stored on the server. Currently, all data management is covered by the sTEAM server. Using an interface that is currently under development, it will be possible to connect sTEAM to a database in the future, thus allowing the use of multimedia documents stored in that database or of hypermedia objects stored on a Hyperwave server. Thereby, sTEAM can easily be integrated into existing web environments. All objects like hypertexts, images, links, users etc. have a number of common attributes that are used to control the details about objects such as name, access rights, owner, creation date, expiration date etc. and methods. In addition, some objects have special attributes and methods such as an associated MIME-Type and a download method for documents or a method "talk to" for user objects. Users can also add their own generic attributes to objects. By default, the user object has a virtual container object, that can be seen as a "suitcase" that the user carries along. Any objects they want to take along, even exits, can be stored in this suitcase and stay there until taken out. sTEAM features a sophisticated security scheme resembling that of Hyperwave with one significant difference: User groups can be defined by any user, as they are just objects on the server which have attributes. Just as rooms, user groups can thus be created on-the-fly. So, if some team of students decides that they are a group which needs to share access rights, they create a group object.

The client deals as the interface between the user and the functionality given by the server and has to be easy-to-use and platform independent. The last requirement was the reason for its implementation in Java. In order to create an easy-to-use interface we restricted the view of the virtual environment to a simple 2d-representation. The view is made up of three areas, showing the users currently in this room, the interior of the room, i.e. the objects including exits to other rooms, and the communication area. Here, the user can type text to chat and talk or communicate in other text based ways. All of these objects, even the users, are subject to direct manipulation. E.g., you can "talk to" other users, "download" documents, or move to other rooms with just a mouse click on the respective object. More sophisticated functions including creation of new objects and file upload can be accessed by menus.

According to the view presented above we are developing sTEAM under two main aspects. As a first goal, sTEAM will serve as a research platform for studying new forms of cooperation and collaboration between students. sTEAM closes the gap between classical information and communication technology allowing the users to actively structure their document space while setting up communication channels between them. As a second aspect, the flexible design allows the fast and easy creation of special clients to study questions of human computer interaction or new forms of collaboration technology.

5 Conclusion

We have described two concepts for individual and collaborative use of hypermedia course material. Semantic Spaces allow learners to organize hypermedia documents according to their individual needs. These spaces serve as means of orientation and navigation. A collaborative virtual environment called sTEAM establishes a virtual working environment in which groups can meet to work on certain topic areas. Social contacts between students can thus be augmented by the system. Both systems have been implemented as prototypes and will consequently be evaluated. Future plans include the integration of Semantic Spaces and sTEAM to allow for an easy transition between individual and group learning processes.

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Dynamically Generated Tables of Contents as Guided Tours in Adaptive Hypermedia Systems

Achim Steinacker, Cornelia Seeberg, Klaus Reichenberger, Stephan Fischer and Ralf Steinmetz
Industrial Process and System Communications
Darmstadt University of Technology
Merckstr. 25, D-64283 Darmstadt, Germany
GMD IPSI
German National Research Center for Informtion Technology
Dolivostr. 15, D-64293 Darmstadt, Germany
{Achim.Steinacker,Cornelia.Seeberg,Klaus.Reichenberger,Stephan.Fischer,Ralf.Steinmetz}@kom.tu-darmstadt.de

Abstract: The Multibook project of the Darmstadt University of Technology builds a webbased adaptive hypermedia teaching and learning environment for multimedia and communication technology. Hereby, the demands of diverse user groups, user levels and especially of diverse learning strategies are taken into account. Besides information gained from the interaction with the user, the system uses standardized content relations and meta-information to adaptively compile a selection from the set of available information units. A subset of the meta-information represents the compiled lesson on a high level and is presented to the learner as a dynamically generated table of contents.

1. Motivation

"Imagine everything is available and tied together. Grand visions come to mind of what things will be like when 'it's all there and linked'. The thought of that great body of material calls to us, calls to us like an ocean. ...' But that ocean of universal hypertext is not enough: we want free sailing on it."[10]

So why should we restrict this demanded freedom of navigation? There are many applications where it makes sense to guide the user to a certain amount. One of these are learning environments. If the use of such a system is supposed to lead to an intersubjectively measurable learning effect, it must be guaranteed that the user has seen/learnt certain parts of information, and doesn't get completely lost on his/her way. Hence the decision where to go cannot be entirely up to the user.

The solution we are going for is to offer a special form of guided tours comparable to those of a classical hypermedia system. It's our concern to build a system, in which we can generate tours dynamically. We offer these guided tours to the user in form of tables of contents, that structures a relevant subset of the material. We see this as a suitable way to overcome the gap between a linear ordered text and free navigation.

2. Related Work

Recently, ideas from intelligent tutoring systems (ITS) and from hypermedia have been brought together opening the field of adaptive hypermedia. This synthesis responds to the specific strengths and weaknesses of both approaches. ITS [1],[4],[15] provide a high level of guidance in learning, they model and control the entire learning process in great detail. A domain model representing all facts of the field that are to be learnt, usually forms the background for a model of the learner's knowledge and knowledge acquisition. Free exploration by the learner does not play an important role in ITS, the navigation decisions are very much up to the system. As discussed in [6], most of the existing ITS systems are environments for coding and testing a specific programming language. Furthermore, users often need considerable time for learning how to use an ITS, because the development of an intuitive user interface for ITS systems seems to be a very difficult task. Hypertext and hypermedia systems exploit the nature of different media such as text, pictures, audio, video or simulations as a medium for making differentiated statements and communicating less structured knowledge. In addition, a hypermedia system offers more than predefined learning paths - by selecting different nodes in different order, the individual learners produce a multitude of paths through the material. The drawback of these systems is that the learning process cannot be controlled in a well defined way. This results in insufficient guidance. In particular when used for educational purposes, hypermedia systems are striving for a higher degree of control [7],[3]. We regard as decisive the step of adding conceptual information on top of the hypermedia chunks, being the basis for their intelligent selection and sequencing. Connecting the concepts with semantic rather than didactic relations that would already imply sequences or dependencies among the concepts [2] provides yet a higher degree of flexibility - this way, the concept space lends itself to realizing different learning strategies and goals but also to tasks like information retrieval.

The Interbook project is a well known adaptive hypermedia system, which also makes use of a concept space, called domain model [8]. Interbook supports navigation through the lesson with adaptive annotation, showing the type and the educational state ("ready to be learnt", "recommended", "not ready to be learnt") of each offered link. Interbook is based on the domain modelling approach of ELM-ART, a WWW version of ELM-PE, that is currently one of the most advanced intelligent learning environments for programming. In the online description of Interbook the term "I3-textbooks" (integrated + interactive + intelligent textbook) is suggested for approaches which integrate on-line representation of learning material with the interactivity of problem solving environments and intelligence of ITS. In this sense, the Multibook project can be seen as a specific type of an I3-textbook, although our application domain brings along some different problems which requires slightly different approaches and techniques, which we will describe in the remainder of this article.

3. Multibook

3.1 Constraints and Requirements

The content of the Multibook system, currently being developed at the TU Darmstadt, is the printed book "Multimedia: Computing, Communications & Applications" by Ralf Steinmetz and Klara Nahrstedt consisting of about 1200 pages, and a selection of Java applets [13]. The aim of Multibook is to have individual views on this material according to the needs and preferences of the individual users. A linear, printed book does not satisfy these requirements: It does not adapt flexibly to the level of difficulty, the learning aim, the learning strategy and the media preferences of the specific user. Apart from that, many aspects of multimedia technology can be explained better using motion and interactivity. A pure hypertext or hypermedia system does not satisfy these requirements either. A hypertext is static, in that the text is either heavily linked and there is a suitable path through it for every user - then the user might be confused by the number of possibilities and not be able to find this path. Or there are only a few links, then it will probably not satisfy the demands of each individual user. An ITS system does satisfy these requirements, but these systems only work in areas which are highly structured, such as Mathematics and especially programming languages. The level of control and the detailed knowledge of the state of the user can't be achieved in our subject domain. To formally model everything that can be said about multimedia in texts or images would not be a feasible approach. Also the extent and the extensibility of our material and the amount of text describing it are constraints which make it impossible to guide the user in such a controlled way.

3.2 Approach

The Multibook system has multiple facets: it provides an intelligent testing environment for the user, offers search facilities for a direct access, etc. In this article, however, we will focus on the main task: To find and to propose a suitable path, hence a suitable composed lesson. To be able to acomplish this, the content and meta information concerning the content must be represented in a formal way, that enables the system to operate on it. As a result the system can play the role of a guide for the user. In order to find a suitable path, the system makes use of a user profile and of the meta information. In the beginning, the profile is filled with the demands and preferences of the learner. There are two spaces in which the knowledge base is modelled: a domain model, which we call the ConceptSpace, and the MediaBrickSpace, where knowledge is represented in small modular pieces of text, in images etc. The concepts and the actual content are therefore separated. The ConceptSpace represents the domain, the MediaBrickSpace is a set of possible explanations of this domain. The concepts are comparable to possible chapter headings and are interconnected by semantic relations. There are different possibilities to choose a set of relations. The granularity of the model relates to the fact that we are interested in roughly structuring the domain rather than completely representing all facts. In the vocabulary of Knowledge Engineering, this makes our ConceptSpace a terminological rather than a axiomatic ontology [12]. We are aware of the benefits that the extended use of verb concepts, and the expression of a greater variety of facts they allow, could have for our domain. However, the current model is, for simplicity reasons, mainly built around noun concepts [5]. Semantic relations strongly guide the composition of lessons but do not predetermine a unique set of topics and the order of these, to make application of different learning strategies possible

In the following we will describe in an exemplary way the rules that operate on the different categories of the profile and on the relations in the ConceptSpace to compile a adequate outline for a lesson.

The rules which are responsible for choosing the global structure of the lesson use the semantic relations corresponding to the learning aim. Note that these rules are not a hardwired part of the system. At this stage, we

modeled some rather straightforward didactic rules ourselves, later we want to give the domain experts working with the system the possibility to specifiy their own rules. Examples for rules using the semantic relations: In his/her profile, the user is characterized as a student learning for exams. In this case the system will search for concepts which are related to the chosen topic by the relations "uses", "part_of" and "is_a".The selection of the topics has to be coordinated with their order arising from the chosen learning strategy, e.g., hierachical: Definition - broader term- component - application. In other cases the selection of the topics uses, on a small scale, inferences on the ConceptSpace. Example: The topic is related to another by the relation "problem". Then the system would most probably find a concept representing a solution for this problem among the more specific concepts (i.e. one that is connected by a "is_a" relation). The lessons are finally put together by combining a set of media bricks. They can be in form of text or other multimedia elements such as images, graphics, video and audio streams and - with the main focus - animations realized as Java applets. Also these multimedia elements satisfy the requirements of modularity. This requires that the format of the media bricks enables the system to describe the content, grade of detail, and the underlying pedagogical concept of the media brick. Thus it is possible to integrate a media brick in a lesson, independent of the kind of media. Particular emphasis of our work lies on the issue of coherence [14]. When a user of a hypertext does not have the possibility to choose the pages, i.e. he/she cannot establish the relation between the parts of the lesson by himself/herself, he/she is more likely to expect a coherent lesson, a lesson where the relations between the parts are obvious, although they are put together by someone else. For this purpose the media bricks are not only linked to the corresponding concept but also interconnected in the MediaBrickSpace by rhetorical relations based on the Rhetorical Structure Theory [9] [11]. Examples for such rhetorical relations are "deepen" or "explain". It is a major task of the system, to make this relations explicit.
In general, the rules for building the lesson out of the relevant media bricks, have to use the rhetorical relations and the characteristic of the media bricks, in order to match the users level of difficulty, media preferences and coherence expectations. Simultaneously, they have to work off the structure of the lesson compiled earlier and to fulfil the demands of the user's learning strategy. Note that the learning strategy requires rules working on both spaces. These goals are not always easily harmonized: The system will, for instance tend to select as the next media brick one that is connected to the current one but also one that is connected to the next topic in the planned structure.

4. A Table of Contents for each User!

As an example how we overcome the gap between free navigation and static guidance by using the meta-information described above, we suggest a dynamically generated table of contents. Dynamically generated tables of contents combine the best of both worlds: The interests of the user are made manifest by the outline, the structure, of the lesson. This task can be achieved by applying the user profile instead of constraining the user to choose the media bricks by himself/herself. As with a guided tour the lessons are coherent, and more security is given to a sensible course of text/media. Rules working on the ConceptSpace are responsible for creating the outline according to the user profile; rules working on the MediaBrickSpace are responsible for the coherence of the lesson.

4.1 Tables of Contents

Tables of contents, what are they and what function do they have? Generally, a table of contents is the rough structure of lessons. Any kind of table of contents is motivated by semantic relations. A table of contents gives the reader an overview of the lessons and shows the view the author has of the subject.Therefore we can consider the table of contents as a path through a net of concepts. We observe that not every path can serve as a table of contents, nor does every structure of a topic make sense. Obviously some proven patterns occur quite often. These characterize a sensible structure for texts. We give three examples:
A structure based on *part_of* relations:

1. Media Server
    - 1.1. Disc Controller
    - 1.2. Storage Management
    - 1.3. File System
        - 1.3.1. Allocation Table
        - 1.3.2. Access Control
    - 1.4. Memory Management

The subchapters describe the components of a media server, the sections of "File System" represent the components

of a file system.
A structure based on *is_a* relations:

1. Image Compression
   1.1. JPEG
   1.2. PNG
   1.3. TIFF

Here the subchapters are examples of the topic of the chapter.
A structure based on *proceeds* relations:

1. JPEG
   1.1. Picture Preparation
   1.2. Picture Processing
   1.3. Quantization
   1.4. Entropy Encoding

The structure of these view follows the order of the process itself.
The structure in each of these three examples is a paths, that is a tree, even leading to multiple trees or forests. It is not necessary that the structure is based only on one kind of relation, hybrid composition can also be observed quite often. There are several reasons why it makes sense to provide explicit guiding for the user in the form of a table of contents:

1. A user in a learning environment has to learn certain topics, if he/she wants it or not.
2. The user may not have the necessary overview of the area to choose the relevant concepts.
3. The user is not able to compose a lesson according to a learning strategy by himself/herself.
4. The knowledge base is too broad to be managed effectively without help from the system. The system can select and combine the media bricks faster and more efficiently than the user.
5. A table of contents offers the user some sort of orientation. He/She can see exactly where he/she is and to which context the current topic belongs.

In the Multibook system there are also situations where "classical" free navigation is the appropriate strategy: The user selects the topics being relevant for him/her from a net of content objects, which is a simplified version of the ConceptSpace where the relations are omitted. The net offers the user an overview of the area with connections between the topics beyond the linear order of a table of contents in a printed book and many hypertext systems. The user can choose the topics without working on the media bricks, thus simplifying the complexity of the knowledge bases.

4.2 Dynamic Table of Contents

Since the aim of the Multibook system is to be adaptive to the needs and preferences of the specific user we need more than just one table of contents: We need a table of contents for each single user. This cannot be obtained by having several static tables of contents. If the set of media bricks would bc static we could precompute every possible way through the material. This means, every possible learning strategy etc., could be realized and presented to the user. But since our system is open for extensions of both ConceptSpace and MediaBrickSpace including media bricks from external sources, we must be able to generate the tours through the material dynamically for every user. Our system is able to fulfil this task because of the partition into ConceptSpace and MediaBrick Space. The concepts/topics are modelled separately from the descriptions, therefore every concept can be picked up to be the main topic. The semantic relations which allow the diverse structuring of the topics make it possible to tell the difference between sensible and senseless structures, i.e. table of contents. The ConceptSpace with its manifold semantic relations is a starting point for different and meaningful ways to construct tables of contents. Topics which are chapter headings in one lesson can be subchapters in another.

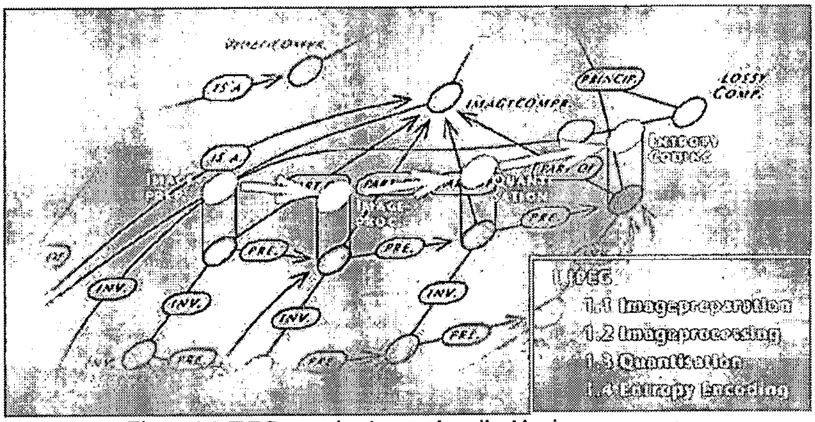

Figure 1.1 JPEG as main chapter described by its components

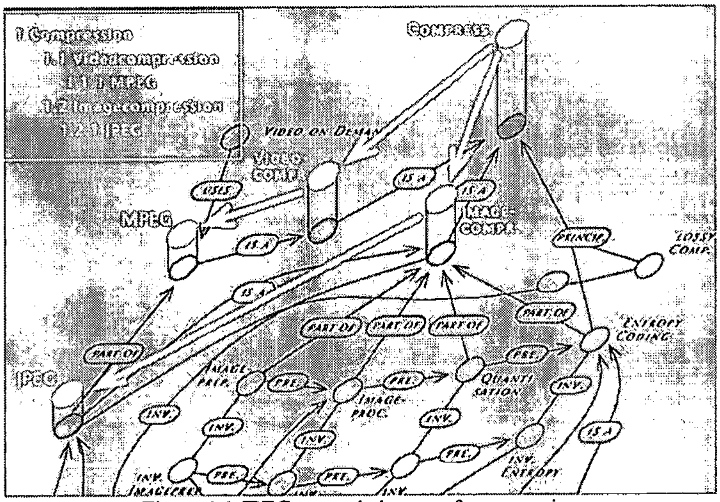

Figure 1.1 JPEG as a subchapter of compression

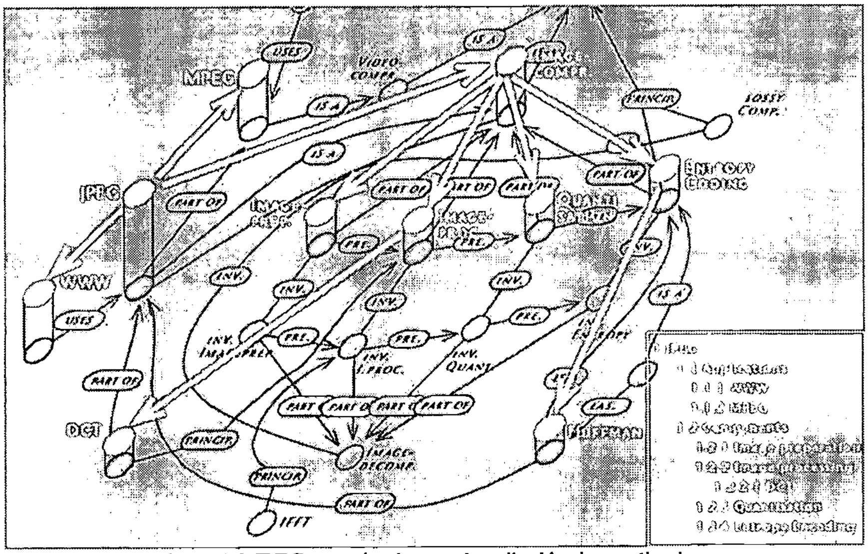

Figure 1.3 JPEG as main chapter described by its applications

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In Figure 1 different views of the complex JPEG are shown. The topics selected for the outline are highlighted in the figures. In Figure 1.1 JPEG is defined by its componenents, in Figure 1.2 JPEG is a subchapter of Compression and is explained in the context of MPEG. In Figure 1.3 JPEG is the main topic of the chapter and is described first by its applications where MPEG is mentioned, then in detail by its components

5. Conclusions and Outlook

The learning strategies we have implemented so far (problem oriented vs. hierachical) are exemplary. Our aim is not to prove whether a certain strategy is under certain circumstances better than another. We rather want to provide a tool for educationalists to conduct these kind of experiments. They can test their theories about learning strategies by applying their research results to our system. The system is flexible for changing the rules in both spaces which are responsible for composing the lessons. As we only recently finished a prototype of our system, an empirical evaluation is now on its way: In a broad field trial at the end of this year with the students of our institute, we will investigate to what extent the individual tables of contents help to navigate on a hypermedia system. A major problem which needs further investigation is how to produce the media bricks. To write a text in a modular way is quite unaccustomed, also a deeper understanding of the relations is necessary to bind new media bricks in the MediaBrickSpace.

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Automated Coursework Assessment over the Internet

Roger Moore*and David Marshall
Department of Computer Science
Cardiff University
PO BOX 912
Cardiff
CF2 3XF
email: {*scm6rm, dave*}*@cs.cf.ac.uk*

Abstract

The automatic assessment of coursework can have significant advantages, especially when dealing with large class sizes. Several automated marking systems have been developed in recent years [BBF93, BBF+94a, BBF+94b, LJ95, TR96], the Ceilidh system probably the most popular and significant. All the systems have basically required the user to manually submit prepared pieces of coursework to the system. In many the cases this is perfect method for submission of coursework. However, with the possibilities offered with internet connections alternative methods where the coursework may be marked directly over internet. This is especially necessary if the coursework involves testing some networking component (*e.g.* Are Web page links (URLs) valid and working, or do CGI scripts operate properly). This paper addresses the practical issues involved in supporting the provision of such a system. The system is demonstrated with implementations of marking students Web Pages for HTML content and Perl/CGI scripts for dynamic correctness and syntax. However, we emphasise that general principles of using the internet as means for automated coursework assessment and general practical solutions to this problem are presented.

1 Introduction

The automatic assessment of coursework can have significant advantages, especially when dealing with large class sizes. It is evident that not all pieces of coursework can be adequately assessed by computer. However, with careful consideration and design of questions a wide variety of topics can be tested. Several automated marking systems have been developed in recent years [BBF93, BBF+94a, BBF+94b, LJ95, TR96], the Ceilidh system probably the most popular and significant. All the systems have basically required the user to manually submit prepared pieces of coursework to the system. In many the cases this is perfect method for submission of coursework. However, with the possibilities offered with internet (or other network) connections alternative methods where the coursework is placed on web pages or specified directories and the work is marked over the network. This is especially necessary if the coursework involves testing some networking component (*e.g.* Are Web page links (URLs) valid and working, or do CGI scripts operate properly when called over the Web).

The provision of automatic assessment can offer enhanced possibilities both for self-study and for class administration. Some of these possibilities are listed below:

- A large number of exercises can be assembled, which students attempt and submit interactively via the courseware. These exercises are then marked by computer and the marks returned to the students. In many cases, the marks can be returned almost immediately. Breakdowns of the marks can usually be supplied — thereby providing additional feedback to the students. Model solutions can also be provided. Many more exercises can be attempted and submitted by students than is possible using conventional lecture techniques — and, of course, this method is suitable for distance learning. The burden of course administration is also significantly reduced.
- Similar submission and marking procedures can be adopted for *assessed* exercises. Additional (electronic) gathering of marks is easily facilitated.

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- Checking for plagiarism can be more comprehensive and consistent.

Clearly different methods of assessment and submission are required for different disciplines.

In recent years, the Ceilidh automatic program marking system has been a popular, stand-alone means of supporting a wide variety of programming language courses [BBF93, BBF+94a, BBF+94b]). We have used Ceilidh extensively for C programming courses at our institution for many years. Current research, we are undertaking, is investigating the possibility of utilising advanced Ceilidh features to enhance the marking process described in this paper. Ceilidh is now quite widely used in many programming and software engineering courses — both in the UK and overseas. In addition to administering coursework submission and marking, the full Ceilidh system also supports lecture notes. Unfortunately, the lecture support structure does not fit in with our philosophy of delivering courseware over the WWW, which has always been a major aim of the courseware we have developed [Mar95, Mar98a, Mar98b, MH96a, MH96b, MH97]. However, the automated coursework marking tools are extremely powerful. We have (for the C course) provided an integrated Web-based courseware environment that called upon Ceilidh's facilities for marking students' programs. Essentially a Web form interface has been provided for students to submit their programs. A similar system is now provided by the original Ceilidh developers (see http://www.cs.nott.ac.uk/~ceilidh/).

Other relevant systems for automated program assessment include PASS [TR96] which has addressed wider issues of syntax and grammar analysis of submitted (C) programs and BOSS [LJ95] which has provided a user-friendly interface for online submission and supports several programming based courses.

However, the submission mechanism over the Web is not always ideal. We have found from our experiences with C coursework online submission that it is cumbersome for students to develop their programs externally of the courseware the ensure that work correctly (compiling, debugging, test runs) and then submit by essentially cutting and pasting the source code into a Web-based form. More importantly in order to assess that certain pieces of coursework work according to specification they may actually need to test to run over a network. A system is there required, with many general applications, which in networked based and user simply provide solutions to pieces of coursework by placing on a Web-page or in a directory which can be accessed via a network. A few systems for assessing the validity of HTML for Web Browser Support[Add98] and generally interpreting HTML[CAS98, EWS98] have also appeared on the WWW recently.

The principle aim of this paper is an investigation into the practical issues involved in supporting the provision of such a system. The system is demonstrated with implementations of marking students Web Pages for HTML content and CGI/Perl scripts. However, general principles of using the internet as means for automated coursework assessment and general practical solutions to this problem are presented.

2 The Assessed Coursework — Internet Computing

With over 100 students taking the Internet Computing (Year 1, BSc Course), an alternative to 'marking by hand' was required. Several assessed exercises of coursework to test students understanding of other internet concepts such as searching, ftp and email[Mar98b]. However the major piece of assessed coursework involved developing a Web page and writing some CGI/Perl programs with a HTML form interface. By careful consideration of the web page content and CGI-based tasks it was possible to devise effective exercises that could be marked online.

Students were set specific tasks to achieve in HTML for their Web page, such as having to include certain HTML formatting including images, and Web links on their Web pages. For example students were requested to put their name, college address *etc.* in certain font styles and formats, and to include an image of themselves. Students were also required to find and provide (external) links to web pages that address a particular topic. By choosing topics that have an abundance of web pages devoted to the topic (VRML, Perl and Video were used this year) one can ensure that students can easily find such pages on the Web. Also it is not unreasonable to assume that Web pages should include the topic name in Web page headers, title or main text which can easily be searched for to verify the relevance of the Web page.

CGI programming exercises were devised such that they have a specified input and output. Therefore the CGI scripts can be called via a Perl script with arguments specified within the URL and the output checked by Perl pattern matching. The content of the Perl source may also be checked. The CGI programming exercises that were currently set involved producing a simple online calculator or image browser in Perl which were automatically marked. The marking system developed is modular and other exercises are planned as alternatives in the near future.

3 Assessing Web Page and CGI Programming Exercises

As mentioned above students were set specific Web programming tasks to achieve using HTML and CGI/Perl. Basically the marking system involves scanning the students' Web pages to verify content and links by simple pattern matching. Web links can be verified by following the URL given and checking if the Web link exists and if the content is valid. Links to the CGI/Perl exercise were also identified and followed. The CGI/Perl programs were then analysed for dynamic (runtime) correctness and syntax. Marks are accumulated by the system as set criteria are met. A configuration file for each exercise is used to set the appropriate mark values for each task. The system is implemented using Perl.

3.1 Restrictions Imposed by Current System

In order to achieve the above automated marking some (not unreasonable) restrictions have had to be applied. These restriction do not pose and real limit to our system and can be enforced as part of the exercise as described below:

- Students Exercise Home page must have specified location and content — All students have allocated web space which can be easily accessed in a methodical manner (*e.g.* http://www.cs.cf.ac.uk/User/Student_Name). Therefore a student class list is assembled offline and this list is read by the marking system. For each student in turn the system accesses their web space and searches for a prescribed web page (*exercise.html* for example). The student web page location, system configurations and exercise names are input variables to the system. In order that the CGI programming exercises may be located these must also be specified. Since the students have been asked to produce a HTML page that must adhere to certain criteria this insistence of providing links can be readily into incorporated this part of the assessment.

  Other systems [Add98, CAS98, EWS98] for more general assessment of HTML. In the future we intend to incorporate some of these ideas into our system to make it more robust and general. Our system implements a very simple method of parsing the HTML that basically verifies that all HTML tags match up and then checks for specific criteria above to mark the page.

- Student CGI program links must have specified name and method of parameter passing — In order for the link to be found from the exercise page the exercise must have a link that contains a specified name link (*e.g. Perl exercise 1*). CGI programs must also adhere to the standard get/post methods of parameter passing.

- Student CGI programs must have (or be designed to produce) standard output — In order to mark the program dynamically the exercises need to be designed so that specific output is produced which can easily be marked. This is basically a similar requirement to the Ceilidh and other program marking systems. The dynamic output part of the marking scheme is essentially achieved by pattern matching using regular expression. We use the powerful built in regular expression capabilities of Perl to perform our dynamic marking of programs.

3.2 The Automated Marking System

We now outline the basic algorithms for the modules that perform the marking of the HTML and CGI/perl scripts:

Configuration and Main Module(Fig. 1) — This module basically reads various configuration files, sets up the appropriate Web links to students' web pages, calls the appropriate HTML/CGI marking modules and finally assembles the final marking statistics. Having assembled various web links it is relatively straightforward to download web page source to internal structures in the main module using the standard Perl *UserAgent* package[Per98].

HTML Marking Module(Fig. 2) — Students are instructed (as part of the exercise requirement) to constrict a web page of specified content and of a specified name. The exercise page is therefore downloaded, stored internally in the module and then assessed for style and content. Not that we are not marking general HTML style but marking a page against a prescribed format. The format

```
For each student in class do
  begin
    Build home page link
    Get Home page
    Find exercise 1 (HTML)
    Download Exercise 1 page
    Mark HTML page style and content
    Find CGI/Perl exercise links
    Download HTML Form exercise page
    Mark CGI/Perl exercise
  end
```

Figure 1: Main HTML and CGI marking algorithm

is designed so as to give students some individuality to their page design. Some general HTML page style is checked such as overall page length (no more than 1.5 pages) and that the number of images and size of the page downloaded (including image size) is not too large (30 Kbytes). Web page tags are identified and matched according to the specified requirements. Students are also required to find and provide (external) links to web pages that address a particular topic (*e.g.* VRML, Perl and Video). Web links are found in the HTML exercise page, checked for keywords matching respective topics and the the web link downloaded. The downloaded web page was then searched for occurrences of the keyword. Thus, we can test and mark for the validity of the Web link and the relevance of the web page to the topic.

```
Parse HTML:
   Count number of lines, estimate page length
   Check HTML tags mark according to exercise criteria

Parse graphics:
   Find image tags in page
   Download images in turn
   Check number of images vs size of files

Parse URLs:
   For each line of page
     Check for keyword/URL link
     Download URL link page
     Check URL for Keyword in Title, Header, Main text
```

Figure 2: HTML marking algorithm

CGI/Perl Marking Module(Fig. 3) — Links to the CGI/Perl scripts must be specified from the exercise home page. The link to a HTML form interface is found, downloaded and then parsed to establish the name and URL of the associated Perl script and the name/value pair parameter passing format. The Perl program is then marked in two ways:

- The Perl program is run over the Internet to check that it can run as a CGI script — The URL of the Perl is formed and the argument list is formed from the name/value pair list and appended as an explicit call (*e.g.* http://my_perl_url/my_perl_cgi?name1=value1). The output of the perl script is marked for dynamic correctness.
- The Perl source code is downloaded and code is more rigourously tested for dynamic correctness and syntax in a similar fashion to the Ceilidh system[BBF93, BBF+94a, BBF+94b]. Several test runs against set test data are performed. Marks are awarded and accumulated for passing each test. The precise weighting for each mark is specified by a configuration variable for the test and reflects the appropriate level of the test.The Perl syntax is check by using the Perl *warning diagnostic* command line option (`perl -w`). In reality our implementation is a simple version of Ceilidh's more powerful syntax and error checking. The `perl -w` command performs a UNIX *lint* (line interpreter) type checking enabling us to check for program errors, unused variables *etc.* This diagnostic checking process generates many standard error messages which can be tested for (simple pattern matching). Marks are deducted for the each error found which are again preconfigured and reflect the appropriate severity of the error.

```
Main:
Begin
Analyse HTML form source for:
    name/value pair structure
    find Perl script name and URL

Download Perl script source
If Perl file in CGI directory
   Test_script_over_internet
Analyse_Perl_script
End of Main

Test_script_over_internet:
   Construct Perl calling structure from name/value pair and Perl script URL
   Execute Perl script over the internet
   Analyse feedback for correct answer

Analyse_Perl_script:
   Analyse for dynamic correctness:
      Run script with a variety of input test data
      Analyse output for correct answer
      Mark accordingly
   Analyse script syntax and efficiency:
      Run perl script locally with -w option
      Parse output for error messages
      (Syntax, unused variables etc)
      deduct marks accordingly for respective errors
```

Figure 3: Form/CGI marking algorithm

4 Conclusions and Summary

The system has been implemented and tested on test user web pages and last year's Internet Computing class. The basic framework and approach has been demonstrated to work. The system is still however basic. The biggest limitation is that only a small number of exercise modules have been developed — 1 specific HTML and 2 Perl marking. However, the system has been designed to be modular and it is a simple task to develop new modules. New module development is currently in progress. One limitation in the Perl marking program is that small customised Perl modules need to be developed to mark each CGI/Perl programming exercise. This is because each exercise may have different form interface requirements and there is a need to test each program over a CGI network and locally. From the lessons learned so far an extras level of generalisation of this process may lead to a more streamlined and simpler approach to Perl program assessment module development. We are currently investigating means of achieving this. We have used the Ceilidh automated programming marking system [BBF93] in other courses. Currently, we are developing scripts so that Ceilidh may be used to assist in a more formal assessment of Perl programming style (and, maybe, HTML) programs. We also intend to incorporate more general HTML assessment ideas [Add98, CAS98, EWS98] into our system.

In summary we have outlined a system that is novel in that it is attempting to assess coursework over the Internet which may lead to an alternative means of submission than current systems. Furthermore, such a system is requirement when internetworking skills need to be tested. We have addressed the practical issues involved in supporting the provision of such a system and demonstrated the system with implementations of marking students Web Pages for HTML content and Perl/CGI scripts for dynamic correctness and syntax. However, we believe that the basic approach has outlined general principles of using the Internet as means for automated coursework assessment.

The Internet Computing course is available on the Web at the URL:
`http://www.cs.cf.ac.uk/Dave/Internet/` and anyone interested in obtaining the marking system should contact the authors by email.

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Constructive "Noise in the Channel": Effects of Controversial Forwarded E-mail in a College Residential and Virtual Community

Richard Holeton
Residential Computing
Stanford University
United States
holeton@stanford.edu

Abstract: As part of a case study of electronic community building in a college freshman dorm, discussion list messages were analyzed quantitatively and qualitatively. Messages were categorized by social purpose (housekeeping, social dialogue, or critical dialogue) and as either forwarded messages or original messages. Forwarded messages included jokes, polemics about politics or social issues, and electronic chain letters deemed offensive by some participants – e-mail forms that, along with metadiscussion, have been widely perceived as distractions and impediments to serious online discussion. A series of discussion threads about gender issues, however, reveals that such "noise in the channel" can frequently lead to constructive critical dialogue, both online and offline, in the context of a residential student community.

Introduction

Many studies have analyzed electronic newsgroups, scholarly mailing lists, and other discussion groups as virtual communities (e.g., Rheingold 1994; Herring 1996). Other studies have looked at classroom uses of computer-mediated communication (CMC) and its effects on learning communities (e.g., Cooper & Selfe 1990; Harris & Wambeam 1996; Colomb & Simutis 1996). Only recently, however – in new contexts such as fully-wired college dorms -- have we had the chance to study the interplay between virtual and face-to-face community in residence-based communities. What are the social effects and potentialities of CMC when participants also live and study together? Critics fear that students who spend more and more time in front of computer screens – even "talking" to their teachers, classmates, and dormmates online instead of in person – are becoming more isolated. According to the *New York Times*, "Some scholars say 'plug per pillow' campuses are undermining the ideal of a residential college" (Gabriel 1996). Former hacker-turned technology critic Clifford Stoll says, "We're turning colleges into cubicle-directed electronic experience and denying the importance of learning to work closely with other students and professors, and developing social adeptness" (qtd. in Gabriel 1996).

For such critics, the whole idea of a dorm e-mail discussion list would seem to be antisocial or, at best, superfluous. But as I have argued elsewhere, the fears of Stoll and others are based on dubious either-or and zero-sum assumptions, the faulty notion that computer activities and community-building activities must be mutually exclusive (Holeton 1997). On the contrary, residents of the dorm I studied used their discussion list in highly social ways and even found the list more valuable than traditional or face-to-face media for purposes such as discussing social and political issues. Their live dorm programs and their hallway and dinner discussions often complemented the e-mail list, and vice-versa (Holeton 1997). In this kind of hybrid residential-virtual community, participants share dorm hallways and lounges, bathrooms, mealtimes, social events, and intramural sports teams as well as the electronic discussion space. With the familiarity and intimacy that are missing from distance-based virtual communities, we should not only expect less rudeness or flaming online but we should also question previous assumptions about forwarded e-mail trivia, chain letters, and metadiscussion – in particular the widespread perception that "in written communication these messages constitute noise in the channel that interrupts discourse" (Korenman & Wyatt 1996, p. 239). The poor reputation of metadiscussion in virtual communities is encapsulated in a widely-distributed e-mail joke entitled "How many Internet mail list subscribers does it take to change a light bulb?" Answer: 1,331:

> 1 to change the light bulb and to post to the mail list that the light bulb has been changed
> 14 to share similar experiences of changing light bulbs and how the light bulb could have been

changed differently
7 to caution about the dangers of changing light bulbs
27 to point out spelling/grammar errors in posts about changing light bulbs
53 to flame the spell checkers
156 to write to the list administrator complaining about the light bulb discussion and its inappropriateness to this mail list....
[etc.; about fifteen additional categories of responses typically follow]

Must forwarded messages, inane or offensive jokes, and metadiscussion serve only as time-wasting distractions, irritants, and bandwidth hogs? To what extent, instead, can they function as constructive discussion prompts or make positive contributions to residential and virtual community building?

About the Study

Rinconada House, Wilbur Hall, is an all-freshman dorm of 94 students (including 5 upperclass residence staff) at Stanford University, where during the 1990s all dorms were wired with in-room ethernet connections to complement networked residence computer clusters. The study is based on a complete archive of over 1200 messages posted to the dorm e-mail list for the academic year 1995-96. Rinconada's history includes the use of dorm e-mail discussion lists for a number of years and its 1993 claim as the first college dorm with a home page on the web. My wife and I served as Rinconada's Resident Fellows, faculty leaders of the residence staff who live in an adjacent cottage, from 1990 to 1997, and thus – especially where qualitative judgments are made -- I am necessarily a participant-observer in the study. All the house residents, including the staff, were subscribed to the discussion list. The full study, including data from which this paper is derived, is available on the web at *http://www.stanford.edu/~holeton/wired-pages/wired-main.html*.

The messages were broadly categorized according to three larger social purposes, which suggest a rough hierarchy from lower-order to higher-order uses of CMC:

1. *Housekeeping* (lost and found, arranging meeting times, etc.)
2. *Social dialogue* (publicizing dorm or university events and programs, sharing outside interests, relieving stress, etc.)
3. *Critical dialogue* (discussing social, political, academic, or intellectual matters; discussing dorm community issues or controversies; etc.)[1]

Generally speaking, critical dialogue is the type of discussion encouraged in academia, where matters of social or intellectual importance are negotiated in a reasoned, collegial way, and its inherent value in learning communities will be presumed. Metadiscussion -- discussion about the medium itself or how the list should be used, or "talk about talk" (Korenman & Wyatt 1996, p. 238) – was classified as critical dialogue. Messages were also categorized as either (a) forwarded messages or (b) original messages or replies. Forwarded messages are those passed on to the list by members but whose content originated from a person or organization outside the group (the list was closed to unsolicited junk e-mail or direct "spam" from Internet mass-mailers). In the many cases where forwarded content was framed by the sender's own commentary, I made a judgment about whether the primary content of the message was the forwarded material or the original material.

After measuring the various proportions of these message categories, I analyzed the relationship between forwarded messages and sustained threads of the higher-order, critical dialogue. I also considered the effects, in my observation, on the face-to-face community. My discussion focuses on the most sustained critical dialogue of the year, a series of related threads about gender issues that comprised dozens of messages and lasted most of autumn quarter.

Findings and Discussion

In addition to the numerous political calls to action, urban legends, electronic chain letters, Top Ten lists, and jokes that have proliferated on the Internet, a whole genre of undergraduate e-mail humor has

[1] In designing these categories I was influenced by Ziv's "Taxonomy of Communicative Purposes" (Ziv 1996, Table 2, p. 247).

developed as college students got online throughout the 1990s. Typical titles in this genre include "50 things to tell your professor when you turn your exam in late" and "100 ways to torture your roommate." A more insidious subgenre includes material, often with humorous intent, deemed offensive by women, men, specific ethnic groups, gay or lesbian people, or other social groups. These messages are widely forwarded among college students around the world, and the Rinconada list was no exception.

In terms of larger social purpose, from lower-order to higher-order uses of CMC, 13% of the total messages in 1995-96 were classified as *housekeeping*, 57% as *social dialogue*, and 30% as *critical dialogue*. One-quarter (n=306 out of 1244 or 24.6%) of the total messages were classified as forwarded messages. The vast majority of forwarded messages fell into the *social dialogue* category (and more specifically, the sub-categories "Sharing outside interests" or "Relieving stress"). Of the 711 *social dialogue* messages, 269 or nearly 38% were forwarded messages. See Figure 1.

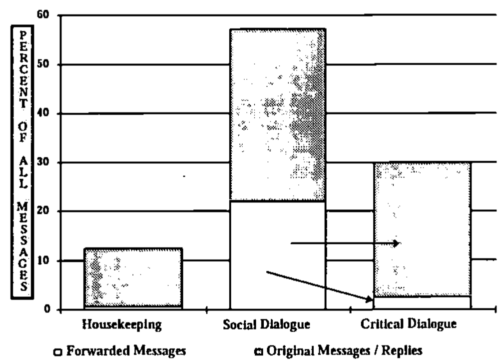

Figure 1: Proportions of Forwarded Messages by Social Purpose. The two arrows indicate that forwarded messages in the *social dialogue* category frequently led to *critical dialogue* messages or to "answering" forwards.

The majority of this busy traffic in forwarded messages were ignored by other participants, so initially we might be tempted to view them, as others have, as "noise in the channel." Anecdotally, some residents reported being put off by common Internet banalities such as those described above. On the other hand, I would argue that there is some inherent value, in a diverse educational community, in participants being exposed to one another's range of interests and passions as reflected in forwarded e-mail messages. Further, a lack of online response doesn't necessarily mean that a joke or piece of trivia wasn't appreciated or didn't provide some needed levity. Residents frequently made offline responses to online chatter, a phenomenon that should be studied further as a potential contributor to community building. Online, some participants answered forwards, playfully or seriously, with another forwarded message taking an alternate or opposing view. For example, a jocular list entitled "How to tell if you're a Republican" would be answered by an equally-jocular "How to tell if you're a Democrat." Sometimes this kind of sparring led to a substantive discussion thread when participants framed their answering forward with extensive editorial comments.

Although many forwarded messages went unanswered, *the most sustained threads of critical dialogue that developed over the year all began as reactions to forwarded messages.* As we might expect, the most controversial or inflammatory messages – those with the most loaded social or political content of interest to undergraduates – evoked the most reaction, including forwards about sex, rape, neo-Nazis, and free speech. The remarkably constructive quality of the dorm's reactions to these prompts, which dispute the claims of pessimists that virtual communities are inevitably being broken down by "flamers, cranks, fetishists and monomaniacs" (Chapman 1995), is revealed especially in the autumn-long discussion threads about gender issues.

Subject: I'm disgusted (fwd)

In October, 1995, an infamously misogynistic e-mail originating at Cornell University called "Top 75 reasons why women (bitches) should not have freedom of speech" was widely disseminated at colleges. It evoked a furor that made national headlines (e.g. Grunwald 1995). Some of the more politely-phrased "reasons" included, "If she's in the kitchen like she should be, no one can hear her anyway" (no. 2), "If she can't speak, she can't cry rape" (no. 38), and "Only one set of lips should be moving at a time" (no. 43). Phyllis[1] forwarded the message to the Rinconada list with the subject header "I'm disgusted," initiating a month-long discussion thread.

Vigorous metadiscussion about the appropriateness of posting the "75 reasons" message to the list ranged from Duncan's plea to "think twice before passing this kind of thing on" to defenses of freedom of speech. The staff did not intervene in this discussion but purposely let residents negotiate norms for the e-mail list, attempt to establish shared values, and, hopefully, assert collaborative ownership of this electronic space. Their initial success is indicated by Adelle's assessment of the metadiscussion (i.e., meta-metadiscussion?): "It was nice that for once people expressed their ideas about e-mail without becoming rude or over personal. I guess people are starting to become more considerate of others over the e-mail. What was so hard about doing this?"

The "four players of Cornell" who composed the controversial message (and even put their real names on it) got flamed from far and wide, issued apologies, and faced disciplinary charges. Meanwhile at Stanford on the Rinconada list, Gregory started a serious discussion of gender issues by objecting to how such incidents reinforce negative stereotypes about men. Several other men participated thoughtfully in this thread. For example, Duncan wrote, "On behalf of my gender I would like to emphasize that the majority of men do not think this way about women, that many find it sick that some people actually perpetrate such filth, and that the guys who wrote this in the first place are probably loving every angry response that they receive."

Subject: Re: Something Serious To Think About (fwd)

Less than two weeks after the "75 reasons" forward, an e-mail chain letter originally called "YOUR PARENTS WERE RIGHT ABOUT THIS ONE" was forwarded to the list by Mona with the new subject header "Something Serious To Think About." Interestingly, Faith had previously sent this message only to the women of the dorm, and now Mona prefaced her posting with explicit appeals to her male dormmates for a continuation of reasoned discussion:

> To all the women of the dorm, sorry for cluttering up your e-mail with a repeated message, but I wanted to send this to the guys, and this was way easier. Guys, please don't take this as an attack on males, cuz it's not. I just thought it was an important message for the state of the world we live in, regardless of gender. Faith was great enough to send this to all the girls, and I thought there might be guys in the dorm who would appreciate it as well (for male/female friends, for themselves, or just as a reminder that you can't trust everyone in this world, unfortunately).

Mona concluded her persuasive preface with gender-neutral appeals to dorm spirit and Stanford spirit ("Rinc Rules and Weenies Got Roasted!" -- a reference to the recent Big Game football victory over Cal-Berkeley). The forwarded narrative itself depicts a generic date rate ("He knocks on the door. She doesn't really know him well, but her friends party with him often. So, she smiles and settles back onto her bed as he walks in...."), offers moral lessons ("we all learned in kindergarten – ask before taking, and don't touch what isn't yours"), and exhorts readers to spread the word:

> This is a chain letter. Send one to the people you care about, or are afraid of. In any school, in any country. Please write the name of your school at the bottom, and place an X beside it if someone you know has been a victim of assault or rape. [A long list of colleges and universities marked with Xs follows.]

In response, the previous thread about male stereotyping evolved into a discussion about rape, with extensive contributions from Gregory, Ronald, Buff, Betty, and others. Gregory and Ronald argued that the generic date rape in the narrative grossly oversimplified what can be a complex series of miscommunications.

[1] All names are pseudonyms.

Buff sent a four-page self-described "treatise" on rape rebutting Gregory's and Ronald's arguments, Ronald sent a rebuttal to the rebuttal, and so on. Six days into the thread, Betty tried to get the discussion refocused on basic feelings and human communication, suggesting that the argument had gotten too analytical and theoretical – a classic example of what some have identified as a female communication style (e.g., Tannen 1994) contrasted with the male "agonistic," warlike debate style (Ong 1981):

> I think it's fine to analyze all the little points of the law and of ethics on a theoretical level, but it seems to me that the real issue here is a lot more broad. It's about respect and communication. You should respect yourself enough to both voice your desires or concerns and then respect your partner enough to ask about their feelings and listen to their response.

Subject: 75 REASONS. PLEASE FORWARD. (fwd)

Yet another forwarded message – "75 Reasons Why Angry Cornell Women (Your Worst Nightmare) Are Exercising Their Freedom of Speech," a reply to the original inflammatory "75 reasons" list – re-ignited the gender threads again in early December. It was posted by Carolyn, Rinconada's Residence Computer Coordinator (RCC), an upperclass member of the residence staff. The Cornell women's message cited a number of statistics from the Women's Action Collective, establishing a scholarly tone. Some men on the Rinconada list, such as King, reacted defensively: "Men are often depicted as villains that suppress and abuse women.... I want to question the validity of some of the statistics given in the message." Ronald questioned the Women's Action Collective's statistics by offering his own research and citations from the *Western Journal of Medicine*, *The New Republic*, and other sources, as in a formal academic paper. And Betty and Clarisse challenged the men with a thread called "Could we just forget semantics for a minute?"

In a virtual *touché* that seemed to go largely under-appreciated by the men, Clarisse connected the political discussion about gender directly to the dorm face-to-face community, chastising the "guys" for referring to Carolyn, the RCC, as "The Computer Lady." Although Clarisse qualified her objection as a "random thing," it wasn't random at all, because of course Carolyn had posted the Cornell women's rebuttal.

Along with Carolyn, the rest of the residence staff had many opportunities to make similar connections between the virtual and the residential community. We organized formal residential education programs with gender themes, such as a consciousness-raising exercise led by the Resident Assistants called "Gender Alliances." Not surprisingly, numerous conversations at meals and late at night in the hallways extended and complemented the online discussions. Such conversations fed back into the e-mail discussion list as more participants got involved; 60% of the dorm's residents participated in critical dialogue threads at one time or another.

Moreover, the value of all this online discussion about gender issues was by no means limited to those who did most of the "talking." A survey I conducted near the end of the year showed that even those who participated little online were active as *readers* of the list and thought it was very useful for discussion of social and political issues. These so-called "lurkers" were not necessarily inactive in the face-to-face community – and vice-versa, the most active e-mail participants were not all similarly active in physical dorm activities (Holeton 1997). Thus, online interaction and offline interaction together offered residents more, often mutually reinforcing ways of communicating, exploring and negotiating ideas, and getting to know one another. In these complex and sometimes surprising ways, the "four players of Cornell," the "Angry Cornell Women," and the purveyors of other chain letters and forwarded messages helped enhance, rather than diminish, the community experience at Rinconada House.

Conclusions

A dorm e-mail discussion list or other electronic discussion space can be very useful for the kinds of critical dialogue encouraged in academia. At least in this higher education context, the kinds of forwarded e-mail trivia, controversial messages, and metadiscussion that have disrupted other virtual communities need not preclude higher-order uses of CMC. Messages forwarded by participants from outsiders, even if annoying, preachy, or distasteful, can prompt substantive discussion and serve as valuable tools for building community. On the Rinconada 1995-96 e-mail list, the most engaging and successful critical dialogue threads of the year started as reactions to controversial forwarded messages.

With the proliferation and specialization of e-mail lists in the late 1990s, some college dorms have begun separating discussion lists from announcement-only lists. This kind of strategy for filtering out forwarded messages might result in missed opportunities for higher-order electronic discussion and associated benefits for the community.

Hybrid virtual-residential communities like today's fully-networked college dorms, where residents have a good deal at stake in their relationships both online and offline, will become increasingly common in the near future. Teachers, residential educators, list administrators, and others with experience in such hybrid communities should continue to explore the effects and best uses of electronic discussion and other emerging technologies.

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Keys to the Culture: Factors in Successful DL Implementation

Dr. Robert Fulkerth, Assistant Professor
School of Technology and Industry
Golden Gate University
San Francisco CA 94105 (USA)
bfulkerth@ggu.edu

Abstract: Distance Learning has become a standard practice in educational institutions. This paper describes an action -oriented approach to that enables anyone, from faculty members to administrators, to become effective change agents for DL. Five factors are discussed:

a. Understanding your Institution: change agents understand their institution, often by taking an outside view.
b. Designing for "Fit": successful DL efforts are aligned with an institution's processes, from curriculum changes to the strategic plans and objectives of stakeholders at all levels.
c. Designing for Quality; Faculty as Intellectual Capital: utilizing the faculty throughout the DL implementation process can create faculty buy-in. Faculty also can provide a perspective on the delivery technology chosen.
d. Designing for Accreditation: as more programs move online, it is necessary to be aware of the expectations of accrediting organizations.
Designing for Integration and Acceptance: activities that smooth the way for DL acceptance inside the school are informational activities, publishing, clarifying intellectual ownership, and providing a technology development center.

Introduction

As Distance Learning continues to become a mainstream educational practice, schools are addressing it less as an innovation and more as a challenge to existing institutional cultures. Those who first taught DL classes and designed delivery systems are now becoming spokespersons and advocates to those in their schools who feel threatened, are not convinced, or are simply not interested.

However, the appearance of online courses, certificates and degrees, many blessed by traditionally-oriented accrediting bodies, is creating a new land rush: rather than the question Should we Go Online, the question in many schools has been jump-started to How Quickly Can We Get There? Acceptance by accreditors, combined with the ubiquity of the World Wide Web and other online course presentation and management tools, is creating a race to mount online programs of all sorts.

Such rapid changes can create tension in the culture of institutions. Instead of the meandering pace of change that schools are used to, Distance Learning has seemingly appeared in the US without precedent or warning (its worldwide history notwithstanding), elbowing aside accepted practices of development and delivery. As well, DL is refocusing debate on issues such as intellectual property, course ownership and faculty workloads.

Fortunately, the knowledge level of decision-makers is on the rise. We're moving from the notion of solitary faculty members designing online courses to an awareness that viable distance programs involve interactive, long-term efforts among diverse institutional constituencies.

This paper discusses an action-oriented approach for DL advocates and change agents to use as they integrate quality-oriented distance delivery courses and programs into an existing school world. After presenting 3 potential DL scenarios, the following issues are discussed:

Understanding your Institution
Designing for "Fit"
Designing for Quality; Faculty as Intellectual Capital
Designing for Accreditation
Designing for Integration and Acceptance

Scenarios

a. One or a few faculty members create and present courses online, probably in a bulletin board, email, or perhaps World Wide Web environment.
   This leads to . . .

b. The school begins to support the development and presentation of courses, certificates and (increasingly) degrees online, in varied delivery modes. There may be some support, but efforts are still by individuals or small groups.

c. The school, recognizing the sea change and the potential that distance education represents, builds multifaceted distance delivery into its mission and its long-and-short-term strategic planning. Distance technologies and development are line items in the budget. The institution does not immediately buy into one delivery mode, but understands that tools and approaches continue to evolve. Faculty and development staffs are adequately supported in development and research, and, in return, they operate with reasonable performance expectations. Developers are encouraged to understand and use not only the "new traditional" technologies (conferencing, Web and Web-enhanced), but emerging technologies.

"C" is very probably fantasy. It's more than likely that you and your institution are at a middle point, with perhaps some distance education implementation in place, probably not enough staff and budgetary support, and an undifferentiated sense of urgency at the administrative level that DL programs need to be developed and implemented.

Theoretically, strategic planning drives institutional activities. In reality, projects that are successful tend to be incorporated into strategic planning after the fact, depending on the degree of their success and the fit they find in a given institution. With that in mind, let's discuss a number of activities (and thought processes) at several levels that can help the change agent move her or his institution toward successful DL planning and integration. First, we need to revisit our institutional culture.

Understanding your Institution

Why is understanding your institution important? The development process may be driven by the DL bandwagon, but it's still directed by the many well-known dynamics of organizational change. These forces (resistance, withholding support, differences in expectations between decision-makers and implementers, conflicts among constituents, a "show me" attitude) are well known and must be recognized to be effectively addressed. Since any culture tends to be invisible to those within it, the change agent who is a member of an institutional community should first step back and take a look at his or her school, with, as the comedian Gallagher says, "new eyes."

Designing for Fit

A subsequent step is to develop meta-objectives for the distance program. Consider the institution's mission and existing programs, and position DL to align with them. This is a fundamental step in creating a long-term support dynamic. Work with stakeholders at all levels, from Board of Trustees members to staff, if possible.

Position any existing DL courses and programs in such a way that they correlate with the emerging objectives of the institutional effort. Ideally, this sort of strategic planning should be addressed before nuts-and-bolts development begins, but in practice, development frequently involves aligning any new programs with an institution's existing culture. Regardless of the situation, the change agent should focus on growing the distance program both within the institutional culture and with an eye toward development and marketing avenues.

Developing for Quality; Faculty as Intellectual Capital

For long term credibility and success, courses and programs should be of the highest quality. Institutional and programmatic quality descriptors may grow out of DL planning, but faculty members should be at the front line of quality at the course content and presentation level. Faculty represent the intellectual and educational capital of the institution, and their contributions should be nurtured and protected as much as possible.

While faculty members are an important resource, they may resist becoming involved with DL for many reasons. An important conflict that invariably arises is the traditional notion that intellectual capital resides with the individual instructor, and is usually manifested in the face-to-face classroom. Expanding this paradigm to fit teaching in the largely unknown territory of virtual space is a complex issue, and it encapsulates other questions of course ownership and intellectual property. Working supportively with faculty is important. It will help resolve such issues, and will demonstrate to the body of faculty members that their contributions to the integrity of the institution are understood and valued.

Another benefit of this perspective is that an intellectual capital approach to planning and design can help forestall the inevitable temptation to choose technology delivery mode over course/program content. If the institution first settles on a delivery mode and provider, (which administrators will tend to do) then content delivery, along with the entire look and feel of your institutional program, will be constrained by the system that is chosen.

If institutional constraints do make it necessary to choose a standardized delivery system, be sure to engage faculty members and developers in understanding how the system allows for the use of technology features as they evolve. Currently, audio/video, web interfaces and the incorporation of course management, multimedia production and presentation are features that are supported by some systems, and not by others. In the near future, any substantial delivery system will have to support video conferencing, interactive database access, streaming media, multimedia, QT/AVI audio/video and World Wide Web access, and users will have to know how to incorporate them into content and course presentation.

Implementing a flexible system is important for another reason. Whatever delivery system is chosen, it will become a traditional organizational entity, which will then resist subsequent intrusions of new technologies and ideas.

Developing for Accreditation

Designing for quality implies attention to translating courses and programs into online environments, not only to attract students but also to maintain standards that will satisfy your school's accrediting body.

Accreditation standards for online programs are still a murky issue, although standards are emerging, and completely online certificates and degrees are appearing. Since institutional accreditation is frequently involved, DL developers should be in close contact with the school's accrediting body. The Western Association of Schools and Colleges, for example, currently allows programs to offer up to 50% of courses in existing programs via online delivery modes before accreditation review is called for. At that point, incremental changes or proposals for online programs must go before the Substantive Change committee for scrutiny. (These requirements are in flux, and may have changed by the time this is published)

Designing for Integration and Acceptance

This concluding section discusses a number of activities and processes that can be undertaken on an ongoing basis. These are some of the "little things" that will, in the long run, help you to open doors for DL development, and that will grow credibility.

• Work toward incorporating DL into the university's administrative and financial structure. There should be distinct budget lines for DL support, delivery and design. The DL entity should have representation on faculty and institutional governance bodies, and should report institutionally at the Vice President level.

• Develop a communication process that shares information and invites involvement from the university community. Giving community members ready access to information about development will encourage awareness and buy-in.

Newsletters, flyers, memos and in-house press releases are effective, but more impact will be created by using the technology itself as a primary communication vehicle, perhaps via an institutional Intranet , groupware activities or an electronic bulletin board. A good introductory use of such technology is newsgroups, or perhaps designing online textbook order forms that faculty are expected to use.

• Implement a user Development Center. Whatever form such a center takes, it should be equipped with high-end technology tools sufficient to allow DL developers to experiment, practice and apply technology ideas. Technological and pedagogical support should be provided. Such a center will have practical application, but the real impact will be its demonstration of the school's commitment to Distance Learning.

• Promote ongoing faculty involvement and ownership of course materials.
Placing courses online for the first time usually involves moving existing content to text-based online activities. This is time consuming but relatively easy, and a traditional course can be translated to a reasonably effective online course this way.

Ideally, this first time translation is only the first step in growing a sophisticated online course that utilizes the many technology tools available. Faculty should be involved (and supported) in course development over time. If ownership and subsequent development of online courses are handed off to the distance learning entity as soon as a course is transferred, then quality may flag, because the interest and expertise of the primary instructor will be lost.

• DL practitioners should be encouraged to demonstrate, present and publish, in both local and larger venues.

• Encourage early adopters and innovators, wherever they are found. They are role models for others, and they will continue to demonstrate how technology can be used in obvious and less-than-obvious ways. If they are involved in development or if they use the Development Center, not only their discoveries but also their processes for using technology can be codified and shared with others.

• Share progress internally and in the public community. This can mean providing copy for student and faculty newspapers as well as local media. Schools are notoriously memo-centric, so non-traditional venues for sharing successes should be chosen to ensure attention.

• Value and use technology innovation wherever it is found and whoever provides it. Technology, concept and content skills may be found everywhere in a school community. Integrate the skills and efforts of those innovators into DL program development.

Conclusion

Finding keys to unlock a school's culture is a difficult challenge, particularly when changes are occurring quickly, under the impetus of external pressure. College teachers, staff and administrators who believe in DL are finding that they have to quickly develop and apply new skills outside the envelope of their normal job descriptions. Any expertise they develop has to quickly be shared with colleagues, in order to make cultural changes happen. But Distance Learning, whether we think of it as a new paradigm or one of many extensions of the old, is clearly broadening educational horizons. Advocates for Distance learning who understand its potential can provide the leadership to move their colleagues and schools toward successful integration of this exciting new educational opportunity.

Virtual Reality in Engineering Instruction:
In Search of the Best Learning Procedures

Alessandro Antonietti
Center for the Research on the Technologies of Instruction (CRTI) and
Cognitive Psychology Laboratory, Catholic University of Sacred Heart, Milano (Italy)
antoniet@mi.unicatt.it

Ernesto Imperio
Institute of Industrial Technologies and Automation, National Research Council, Milano (Italy)
imperio@itia.mi.cnr.it

Chiara Rasi
Cognitive Psychology Laboratory, Catholic University of Sacred Heart, Milano (Italy)
chrasi@galactica.it

Marco Sacco
Institute of Industrial Technologies and Automation, National Research Council, Milano (Italy)
sacco@itia.mi.cnr.it

Abstract: The present study describes a prototypal system for machine tools teaching in a Virtual Reality environment integrated with hypermedia. The goal is to lead students not only to understand the structure and functioning of the lathe, but also to use such a machine. To reach this, the prototype tries to foster conceptual changes in students' mental models and to increase students' control over the learning process. A series of experimental tests have been carried out to assess the educational validity of the instructional tool which has been devised. The aim of the first phase of the project was to assess whether students could use easily the virtual lathe and to verify what they learn about such a machine. The purpose of the second phase was to focus on some critical aspects of the learning process activated by using the virtual lathe in order to realize which are the instructional procedures which give the best learning outcomes.

Current Needs in Engineering Instruction

There are many multimedia teaching aids available for engineering education. However, the problems currently encountered in the use of such instructional tools account for the computer packages' reduced interactivity, for the impossibility of on-line assessment of students' competence levels and of relevant feedback, for the difficulty to integrate the presentation of notions and concepts with the active exploration that software allows, and so on. Furthermore, educational packages often lack of user friendliness, are not always adapted to the needs of either teachers or learners, the networking is rarely sufficient, and traditional pedagogical methods have certain difficulties in integrating the contributions of didactic multimedia. In addition, the products designed and distributed are seldom modular, open-ended, and sufficiently flexible to fill the different goals of the users. Finally, there have been few attempts to validate experimentally the efficacy of computer-assisted courses.

To devise better products for teaching and learning scientific and technological topics, collaboration among Information Technology engineers, didactics experts, cognitive psychologists, and software developers is needed. In this way users will have validated products available along with technical and pedagogical assistance from specialised institutions.

In order to reach this goal, accurate researches are requested, particularly in three fields:

- in the cognitive sciences field, to the extent that it is in particular a question of increasing the pertinence of the trainee model by observing and reconstructing students' spontaneous learning process;

- in the information science field, in order to improve traceability and guidance of individual activities or joint-solving training pursued by the student;
- in the expert systems and artificial intelligence field, to allow the creation of innovative telematic procedures which can amplify the range of their use.

The results of this research will favour the definition of a new pedagogical approach which will be more individualized and interactive both for students and for teachers. More precisely, at the service of didactic innovation, the instructional tools to be devised should allow personalised training and the learner's activity should be privileged by favouring an immediate evaluation of his or her actions, among other things, as well as the apprehension of all the information available in the learning environment. In other words, the development of didactic frameworks corresponding to the students' customised requirements, either in person or remotely, in different teaching contexts are needed. Moreover, a methodology for these innovative practices based on interaction, tracing and intelligent guidance to improve every student's performance should be shared. For example, new teacher-training methods and the elaboration of new learning situations which call on games, exercises, interactivity and problem solving should be developed. Further innovations targeted are the adaptability of the media to different contents, cultural environments and cognitive profiles.

The purpose of the project described in this paper is to present an instructional tool to be used in engineering education which integrates hypermedia and virtual reality and to discuss the results of some experimental investigations aimed at evaluating its pertinence and at assessing which are the best procedures to train students. The long-term goal of the project is to produce, thanks to the progress achieved both in software tools and in learning devices, an high-quality course to disseminate innovative methods for engineering teaching accessible to the greatest number and at reduced cost.

The Virtual Factory

The possibility to use a Virtual Reality system for teaching and/or training surely offers a series of advantages: learning efficacy, safety in the interaction (because the knowledge objects are virtual) and cheapness of didactic mission (because the computer system replaces the didactic equipment and the machinery, generally existing in the technical/scientific laboratories). The efficacy of the didactic mission increases because with Virtual Reality it is possible to integrate, but not to replace, the traditional knowledge processes, based on a symbolic-reconstructive approach (for example, using books, language or logic connections), with the natural knowledge process based on a perceptive-motor approach. Finally, Virtual Reality in the field of engineering is thought to make easy learning and training in using machine tools; it utilizes different teaching techniques thanks to different didactic paths depending on the kind of user (student, worker) and on his/her cultural and vocational level. The representation techniques of Virtual Reality allow to model all elements, that are the objects of lessons, at different complexity stages, to foster a progressive learning of the subjects.

On these grounds, the project aims to realize a prototypal system to teach the utilization of machine tools through a desktop Virtual Reality-hypermedia integrated environment. The prototype regards a manual centre lathe [Boer et al. 1997]. It will allow, on one hand, to implement in a virtual environment typical exercises of a manufacturing laboratory, eventually performable with the aid of the hypermedia environment, and, on the other hand, to set a graphic computer network that is able to share interactively the same synthetic environment. The virtual lathe is addressed to students that attend the last three years of technical-industrial schools and engineering faculty courses. This application could easily be introduced in the industry (maintenance courses, NC-machine tools programming, products marketing).

The prototypal system consists of a traditional centre lathe (fundamental machine tool, both historically and industrially, mainly dedicated to the machining of cylindrical workpieces), in the virtual environment, and of the master environment, which contains technical information and didactic instructions. The two environments have been integrated to work together.

The project is based upon a logical structure called A.I.A.D.I. (Italian acronym of "Direct and Indirect Learning Integrated Environment"). It consists of two main environments (Virtual Reality and hypermedia), plus a third environment which has the function of introducing the student into the system and of allowing to choose among some proposed alternatives, regarding the type of exercise and the learning modality.

The lathe consists of a set of components (structures, piece supports, parts for the information transfer and control) that receive power, data, and materials with the goal to modify their physical characteristic by a sequence of operations. From the operative point of view, the machine tool presents some mechanical components that are in relative movement and therefore it is necessary to define their own kinematics characteristics and their movement synchronization according to the specific operation. A set of technological parameters comes into play; these, if rightly fixed and linked, allow the reaching of the productive goal.

The *Virtual Reality environment* allows to learn the machine tool (declarative knowledge) and to learn its use (procedural knowledge) within a realistic situation, performing practical operations, both physical (i.e., piece positioning on machine tool and cutting tool movement) and conceptual (i.e., choice of cutting tool from the virtual store, choice of cutting speed). First the lathe has to be prepared with the necessary accessories; then all the necessary parameters have to be set; finally, the user can perform the assigned task according to the drawing previously showed. The virtual machine gives a feedback at each step.

The design of the *hypermedia environment* is based on the concept of "structured approach"; it may reduce the risk of "getting lost in hyperspace", that is not to know how to go back to the starting point and the risk of obtaining a so called "spaghetti document", that is a document containing a lot of pages, each one with a short piece of information, which doesn't let the user learn effectively the concept. The chosen model for this application is called HDM+ (Hypermedia Design Model). The hypermedia environment represents the knowledge store/manager of the system and is comparable with the role of teacher. It lets the student learn through texts, pictures, movies, graphical simulations, and Virtual Reality or real situation demos. It is subdivided into three logical parts: glossary, hypermedia, and simulation. The student can access the hypermedia environment on his request; the structure of the student-computer interaction is open-ended. Five different kinds of lesson are implemented in the system: theoretical, demonstration, guided practicing, free practicing, and examination; student is allowed to choose the kind of lesson and change it at any time. *Theoretical lesson* is worked out only in the hypermedia environment: the system explains the information related to the chosen item. In the same environment the *demonstration lesson* is available; it consists of two demos related to the chosen manufacturing cycle. In the *guided practicing* the student performs the manufacturing cycle step by step under suggestions and control of the system; each step consists of three phases: "what to do", "how to do", and "to do". In the *free practicing* the student performs the chosen task in the Virtual Reality environment and he or she can take information from the hypermedia environment, and the system shows the results at the end of job or stops the lesson if mistakes occur. Finally, the *examination lesson*, is similar to the previous kind of lesson except the hypermedia environment is inaccessible.

The prototypal system has been realized on a personal computer (Pentium processor, 32MB RAM) using VRT 4-00 Superscape, for the implementation of the virtual environment, and Multimedia Toolbook 4.00 for the realization of the hypermedia environment.

An Experimental Study

Aim

A pilot study demonstrated that the machine prototype enables students to learn what a lathe is and how it works. The next step of the project was to devise the best procedure to train students. As far as this need was concerned, a critical question to be addressed was: is it better that students begin their training by navigating the virtual lathe or by facing the hypermedia? This was crucial in order to identify the relevant steps of the learning process in which students have to be engaged.

To answer the above mentioned question, an experiment was carried out by analyzing a specific learning situation, that is, the set up of the lathe.

Method

Three groups of novice university students were assigned to the following learning conditions:

Virtual Reality - Lathe = participants navigated freely the virtual lathe before reading hypertextual information;
Virtual Reality - Neutral = participants navigated freely a virtual environment (a room) with no connection with the lathe before reading hypertextual information;
Hypermedia = participants read the hypertext about the lathe without having navigated the virtual environment before.

Indices were obtained from the students:
- by observing their behavior
- by administering questionnaires about:
 . computer using skills
 . naive representation of the lathe
 . knowledge presented through the hypermedia
 . the role of Virtual Reality in education

The sequences of tasks for each group were the following:

A) Virtual Reality - Lathe condition
- computer using skills questionnaire
- questionnaire about the representation of the lathe (1)
- free navigation of the virtual lathe
- questionnaire about the representation of the lathe (2)
- experience with hypermedia
- questionnaire about hypermedia information
- set up of the lathe in the virtual environment
- questionnaire about the representation of the lathe (3)
- questionnaire about the role of Virtual Reality in education

B) Virtual Reality - Neutral condition
- computer using skills questionnaire
- questionnaire about the representation of the lathe (1)
- free navigation of the virtual room
- questionnaire about the representation of the lathe (2)
- experience with hypermedia
- questionnaire about hypermedia information
- set up of the lathe in the virtual environment
- questionnaire about the representation of the lathe (3)
- questionnaire about the role of Virtual Reality in education

C) Hypermedia condition
- computer using skills questionnaire
- questionnaire about the representation of the lathe (1)
- experience with hypermedia
- questionnaire about hypermedia information
- set up of the lathe in the virtual environment
- questionnaire about the representation of the lathe (3)
- questionnaire about the role of Virtual Reality in education

Instruments employed in the investigation can be shortly described as follows.
a) The *computer using skills questionnaire* asked students about their knowledge and previous experience with Information Technology; some abilities concerning computer use were assessed through self-evaluation.
b) The *questionnaire about the representation of the lathe* focused on some critical questions. For example, students were asked to describe a lathe, to explain how it works, to list the kinds of manufactured good for which it can be employed, why it may be dangerous, which abilities are requested to use it. The same questionnaire was administered twice (in the Hypermedia condition) or three times (in the Virtual Reality condition).

c) The *questionnaire about hypermedia information* consisted of open questions about specific aspects of the structure and functioning of the lathe which were explained in the hypermedia environment.

d) The *questionnaire about the role of Virtual Reality in education* reported a list of 24 statements, such as "Virtual Reality requires to plan actions", "Virtual reality is good for intuitive people", "Virtual Reality yields incidental learning". Students had to rate on a 5-point scale their agreement with each statement.

Operations required to the students during the experiments were the following.

a) *Free navigation of the virtual environment*: basic instructions for navigation were provided and exemplified; then students were trained in exploring virtual environment by allowing them to navigate ad libitum the Virtual Reality prototype.

b) *Experience with hypermedia*: students could navigate the hypertext about the lathe in order to achieve competence to carry out the set up of the lathe.

c) *Set up of the lathe in the virtual environment*: students employed the virtual machine tool to set it up. Students' behavior was observed and categorized.

Results

Responses given to the *computer using skills questionnaire* showed that familiarity with computer and ability levels were equally distributed between the three groups of participants and that the subsequent behavior during the experience with the virtual lathe did not depended on the variables measured by this questionnaire.

Responses given to the *questionnaire about the representation of the lathe* were converted into scores; the highest was the score, the highest was the quality of the answer. Data indicated that at the beginning of the experiment both the Virtual Reality and the Hypermedia students had no adequate notions about what a lathe is and how it works.

After the free navigation of the virtual lathe, Virtual Reality - Lathe students learned some core concepts about the lathe.

Knowledge presented through hypermedia was acquired by the three groups in the same manner; in fact, the analysis of the responses given to the *questionnaire about hypermedia information* revealed no differences between the three groups of learners.

No differences between the three conditions during the set up of the lathe performed in the virtual environment emerged also by the observation of the students' behavior.

At the end of experience Virtual Reality - Lathe students showed a higher increase in the adequacy of their conception of the lathe (measured by the *questionnaire about the representation of the lathe*) as compared to the Virtual Reality - Neutral and Hypermedia students

Conclusions

The main findings of the experiment can be summarized as follows:

- the virtual lathe prototype can be used to teach what is a lathe and how such a machine works;
- the integration of Virtual Reality and hypermedia allows novice students with no previous training in engineering to understand the essential feature of the lathe;
- improvements in both declarative and procedural knowledge emerged after a short experience with the virtual lathe prototype;
- the initial naive representation of the lathe is restructured thanks to the experience in the virtual environment and a more relevant notion is acquired after the free navigation.
- learning is enhanced when the exploration of the virtual lathe precedes the presentation of the hypertextual information.

Further Developments

On the ground of the experimental work that has been carried out, the final part of the project aims to elaborate and ensure the distribution of a multimedia and virtual reality training tool validated on the basis of a full-scale evaluation of the cognitive processes involved. This product focus above all on customized teaching and the personal attitude for active self-training; its intention is to establish an interactive environment for each learner which favors the immediate evaluation of his or her activities, as well as providing information accessible locally or at a distance within a given context by multiplying the interpersonal communications possibilities thanks to the electronic network. It also imply that teachers must receive appropriate training which leads them to the most effective mastery possible of flexible, open-ended software packages and reinforce their role as pedagogical project initiators and mediators, indispensable in the progress of the training process.

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Reduce Web-Based Classroom Management Efforts by Refining Collaborative Learning Strategies

Chih-Kai Chang
Department of Management Information Science
Lunghwa Institute of Technology
TaoYuan, Taiwan
chihkai@mail.lhit.edu.tw

Abstract: When a Web-based classroom teacher manages a Web-based distance learning system, there can be a substantial burden of preparation work. Hence, an instructor needs a Web site manager to help him/her use tools to manage the Web-based classroom. In fact, some of the more tedious work can be avoided by using proper collaborative learning strategies. To use collaborative learning strategies on Web, a Web-based classroom teacher can use advanced technology for managing learners' portfolios, controlling learning flow, and constructing collaborative learning activities; and he/she can also refine existing collaborative learning strategies, which reduce the requirements of the advanced technology. Furthermore, refining existing collaborative learning strategies can make it easier to implement them in a Web-based classroom. Although there are methodologies for constructing a Web-based collaborative learning system, none specifically address the possibility of refining collaborative learning strategies to work with Web features. The paper surveys some notable collaborative learning strategies as well as proposing guidelines and recommendations for how a Web-based classroom teacher can refine those strategies for use in a Web-based classroom through our technical perspective.

Introduction

"Issues of determining which strategies and how they are used in classrooms, as well as matching proven strategies to classroom needs and measures of intervention fidelity, are targeted as primary areas in need of research." (Gunter & Denny, 1996) Traditionally, an instructor manages a classroom by proper strategies. The properties of strategies that an instructor uses to manage a classroom include group, activity, agenda, role, responsibility, interdependence, etc. Those strategies are called classroom management strategies. Many educators agree that using collaborative learning strategies can reduce an instructor's efforts in classroom management. At the same time, collaborative learning strategies are also required to implement a Web-based distance learning environment to promote learning motivation and learning performance (Leidner, & Fuller, 1997). Hence, guidelines are necessary for an instructor's training needs in using collaborative learning strategies on the Web (Sherry & Morse, 1996). However, in order to construct a Web-based environment for collaborative learning, an instructor must make great efforts to solve technical problems of using Web features for collaborative requirements.

To construct a Web environment for collaborative learning, an instructor first needs to explore the various possible collaborative learning strategies and extract their common characteristics. Then, an instructor may want to see comparisons between the characteristics of collaborative learning strategies and features of the Web. For instance, an instructor may want to know the answers to questions such as 'Are existing Web technologies sufficient for developing a virtual space for collaborative learning?', 'What are the efforts required for an instructor to manage the Web-based classroom after constructing it?', 'Which kind of collaborative learning strategies are most effective on the Web?', 'Does using collaborative learning strategies in a Web classroom work as well as in a traditional classroom?', and etc.. However, both instructor and Web site manager have no guidelines about the relations between the technological efforts and their effectiveness before constructing a Web-based collaborative learning environment. Thus, there should be reports to depict the relationships between technological efforts and collaborative learning strategies from both technical and pedagogical perspectives. Thereafter, a distance learning instructor can coordinate with a Web site manager to construct an effective Web-based classroom with less effort.

The features for a collaborative learning strategy include heterogeneous grouping, interdependence, individual accountability, and group processing (Warschauer, 1997). An instructor may ask the Web site manager to construct all of these features on the Web-based classroom. For instance, an instructor may want to use Team Game Tournament (TGT) collaborative learning strategies. However, a Web server is inherently passive, without a grouping mechanism, so that it is very difficult to construct collaborative learning activities. This problem is called the learning activity construction problem. Furthermore, a TGT strategy must control learning flow among learning activities for its regrouping requirements. That problem is called the learning flow management problem. Besides, the logs of a Web server can not provide enough information for an instructor of the Web-based classroom to make evaluations. That is called the portfolio management problem. To solve those problems from a purely technical perspective, our previous research used active database, workflow, and data cube technology to enhance the capability of a Web server (Chang & Chen, 1997; Chang et al., 1998).

Frequently asked questions about our previous research are "Is so much efforts always needed for a Web site manager to satisfy an instructor's requirements?", or "Does an Web site manager need to construct all features of existing collaborative learning strategies for an instructor to begin practicing collaborative learning activities on the Web?". In fact, the Web site manager's burden can be greatly reduced if the instructor can make an agreement about learning strategies with learners. Hence, the Web site manager can temporarily ignore that requirement and put more effort on other more important requirements. To reduce the Web site manger's efforts, three aspects of an instructor's requirements for using collaborative learning strategies on Web should be considered for refinements.

First, an instructor using a Web-based distance learning system has the difficulty of constructing collaborative learning activities because the Web system does not support role assigning, and learners' behavior recording. If an instructor wants to heterogeneously group learners in a Web-based classroom, the instructor needs to know 'how was a learner's learning performance previously?'; 'Which kind of role is suitable for a learner?'; 'What is the capability of a role, called individual accountability, for a learner in a heterogeneous group?', and so on. The present Web system can neither answer those questions by retrieving information from the large amount of logs, nor endow learners with a role. Hence, a Web site manager may be asked to develop programs for retrieving meaning from the logs of an existing Web-server. These issues are referred as the *heterogeneous grouping* requirements for constructing activities. However, a teacher will have difficulty in constructing a collaborative learning activity because the Web does not support a collaborative style of working. The teacher must arrange the style of collaborative work and define what a group member can do. Furthermore, an instructor should be able to reuse previous learning activities to construct other learning activities. These are referred to *specification and regulation* problems in the activity construction.

Second, an instructor does not have effective tools to control the learning flow to allow learners' interdependence. Some works of previous studies have attempted to manage the learning flow of a learner on the Web, for instance the Guided Tour for Courseware (Hauck, 1996) and Footsteps for a Quiz Activity (Nicol, Smeaton, & Slater, 1995). Those works devised mechanisms for generating dynamic hyperlinks or views of a Web site to help the Web site manger to manage learners' learning flow for collaborative learning. Thus, the Web site manager can easily generate a Web page with specific learning flows instead of rewriting a Web page while instructors modify the collaborative learning strategies. However, that kind of solution requires a workflow mechanism and Web site manager who is skilled at transferring the learning flow of a collaborative learning strategy into the workflow. Furthermore, certain kind of learning flows are difficult to transfer into the workflow mechanism. These issues are called *interdependence* requirements for managing learning flow. A teacher must maintain the progress of an activity because network tools can not automate the agenda of an activity. In addition, progress in agenda of an activity may depend on certain tasks that learners must finish. However, an instructor can not always monitor the progression of a collaborative learning activity. These are called *automating schedule* problems of the learning flow issues.

Third, to analyze a learner's behaviors, an instructor must make a great effort to find pedagogical meanings in the large volume of learners' records. Recording and diagnosing learners' behavior is tedious work for an instructor in a distance learning environment; especially to analyze the interaction patterns of collaborative learning. Although learners' behavior records may have been properly recorded and analyzed, an instructor can not easily determine the group processing from learners' portfolios to refine grouping strategies or learning flow of the collaborative learning strategy. This issue may be called the *group processing* requirements for portfolio management. Consequently, there should be a mechanism for completely recording group processes in a collaborative learning activity. The mechanism should be able to represent all the used data, including generated and navigated. We call this issue the *recording and analyzing* problem of the portfolio management issues.

In other words, a Web site manager or a distance learning instructor must make great effort to construct and manage the additional components of a Web server due to the properties of collaborative learning strategies.

To reduce management efforts for collaborative learning on Web, this paper proposes guidelines for refining collaborative learning strategies to ease the heterogeneous grouping, interdependence, and group processing requirements. Although the proposed guidelines are not generally applicable to all collaborative learning strategies, they do extend our previous research. The point here is that the Web site manager does not have to remember, or be bothered with intricate, yet irrelevant, information; he can remain focused on the validation task at hand. Hence, the Web-based collaborative learning environment will be more easily constructed by a Web site manager and managed by a distance learning instructor.

An illustrative example and guidelines

It is assumed that an instructor would like to construct a collaborative learning strategy, for this example TGT(Team Game Tournament), on Web. The three steps of one round for the TGT collaborative learning strategy are: (1) divide learners into heterogeneous groups for collaboration, (2) regroup learners into tournament for the honor of their own groups, (3) return to their own group for reflection. A learner will get his/her points for his/her group, which is determined in step one, in order of his/her performance in a tournament group. In next round, learners will be assigned to suitable tournament group according their performance in last round. Hence, learners will help each other in the first step to get points for their own group. The purpose of step two is to let every learner have the opportunity to get points for their own group because step two assigns learners to a groups of learners with similar levels. The last step enables learners to reflect on their behavior by returning to their own group and discussing their performance with collaborative partners.

A Web site manager should first construct the required learning activities for TGT, that is discussion activity and tournament activity. For instance, the discussion activity needs heterogeneous learners to help each other learning. Initially, the distance learning instructor should divide learners into heterogeneous groups according their previous learning performance. Thereafter, the Web site manager should develop mechanism for heterogeneous grouping, such as behavior recording, online testing, and so on. Furthermore, the Web site manager has to endow learners with suitable capabilities in an activity, that is the concept of role. Then, the agenda of the collaborative learning activity should be defined and obeyed. A Web site manager has to develop or use additional tools to satisfy the requirements for constructing activities because Web features do not innately include the functionality for constructing activities. In summary, a distance learning instructor may ask the Web site manager to be responsible for the following tasks: (1) Constructing the role mechanism in a collaborative learning activity, (2) Automating and coordinating the agenda for every group in the learning activity, (3) Learners' portfolio analysis. All the above tasks are very complex for implementation on the Web. Hence, it may not be best to directly transform the collaborative learning strategies in a classroom to a Web-based learning environment.

The following sections depict the guidelines for refining collaborative learning strategies to reduce the complexity of implementing them on Web. First, the role mechanism in a collaborative learning activity can be replaced by embedding autonomic systems in the collaborative learning strategies. Then, group moderators can help coordinate the learning flow among groups. Finally, embedding a feedback role can help instructors to determine the group processes in collaborative learning activities.

Autonomic systems instead of role mechanism

In practice, an instructor can reduce both construction and management efforts by embedding autonomic systems into a collaborative learning strategy. For instance, learners can divide themselves into heterogeneous group by ranking each other. An instructor can ask every learner to give a score to the other learners, who are ever in the same discussion activity or tournament activity, as the source for ranking. Instead of providing a mechanism for online testing, the Web site manager just provides the functionality for learners to rank the learning performance of each other. Furthermore, heterogeneous grouping requires a learner's background information, such as race, first language, majority, etc. Most of the information can not be easily collected by distance learning instructors, but learners will know the background of each other and will reveal the knowledge through the ranking function.

The autonomic system should consider the following function:

- Ranking. This functionality of the autonomic system can be used for heterogeneous grouping because the ranking results will categorize learners. For instance, an instructor may ask learners to rank each other from degree A to D about their mastery of a specific topic. Then, the instructor can use the ranking results to group learners. An instructor needs to ask learners to rank only their partners in a group or a competing group because a learner can not know the learning degrees of others that he/she never contacted. The instructor can normalize the ranking results to suit the required number of members in a group if the ranking results are presented in a percentage form.
- Voting. The functionality of the voting mechanism is similar with the ranking functionality, but the purpose of voting functionality is to choose the most suitable learner for a specific role from a group according personal characteristics. Instead of assigning roles to learners, this issue lets learners recommend someone for a role. Hence, the instructor or Web site manager need not make efforts to arrange every learner to his/her suitable role. For instance, the moderator is one of the roles in the discussion activity of the TGT strategy. Because a moderator should be responsible for maintaining the agenda in time and coordinating with other moderators, learners should vote for a learner with proper characteristics to play this role.
- Accountability. This functionality means that a learner's role determines his/her capabilities. In general, the collaborative learning system has to determine what a role does something (Chang & Chen 1997). The instructor can design daily routines for each role to maintain. Consequently, every learner should be responsible for some tasks that can only be executed by the capabilities of his/her playing role.

Consequently, both a Web site manager's burden and an instructor's Web-based classroom management efforts can be reduced by the aforementioned autonomic functionality.

Moderator coordination supports learning flow management

Subsequently, a Web site manager should determine the learning flow among learning activities according to the learning flow of TGT strategy. In other words, the Web site manager should develop a mechanism to coordinate learners of an activity with other learners of the same activity. For instance, the group that first finishes the discussion activity has to wait for other groups. In our previous research, this interdependent relationship is called and-join learning flow, which means that the subsequent learning activity is activated only after all the prior learning activities are finished. And-join is one of the learning flow types that the instructor or Web site manager should make efforts to control. Hence, we previously presented a model for the instructor to depict the learning flow in the requiring collaborative learning strategy, as well as a methodology for the Web site manager to manage the learning flow based on workflow technology (Chang & Chen, 1998).

The requirements of managing learning flows for collaborative learning includes regrouping learners, learning activity coordination, and maintaining strategy constraints. After a collaborative learning activity is finished, learners of the previous learning activity may be arranged into different groups, a process called regrouping learners. For instance, learners in the same discussion group of the TGT strategy will be distributed to different tournament groups. Some collaborative learning strategies need to construct the interdependence relationships among learning activities; hence learning activity coordination is necessary. For instance, in the TGT strategy the tournament activity can not start until all previous discussion activities are finished. Sometimes the collaborative learning strategy should be modified before being applied to some situations, which is called maintaining strategy constraints. For instance, an instructor can not directly use the TGT strategy on thirteen learners because the number of learners can not be exactly grouped.

In addition to using a technical perspective, a distance learning instructor can reduce gaps between the requirements of managing learning flow and workflow technology by adding a coordinate subsystem into his/her collaborative learning strategy. Hence, the requirements for learning flow management can be largely reduced by the coordination of learners play a specific role in every group. If the moderator of the group can notify other moderators of other groups, the Web site manager can ignore the and-join learning flow and make more efforts to manage other kind of learning flow. The moderator of the notified group must agree to reply to the notification after finishing the current learning activity. Similarly, moderators can handle the or-join learning flow requirements, which means that the subsequent learning activity is activated by coordinating agenda if one of the previous learning activities is finished. Consequently, learners are interdependent because they should notify or wait for the notification to do something in the learning flow.

Learners' assessments support evaluating group processing

Finally, the Web site manager must record learners' behavior and learning performance during an activity to permit the heterogeneous grouping and learning flow managing requirements in next stage. Although a Web server can provide system log files, such as learners' access records, a distance learning instructor requires a report with pedagogical meaning. Hence, the Web site manager has to develop or use tools for monitoring, managing, and mining learners' portfolios. Furthermore, the Web site manager should provide a friendly interface for an instructor to understand the generated reports. The purpose of the friendly interface, called multidimensional analysis in our previous works, is to demonstrate reports in any style asked by instructors. However, the issues observed by an instructor are dynamic and can rarely be predicts. Hence, we use the data cube technology to support the Web site manager providing report service to instructors.

A distance learning instructor can help to reduce the Web site manager's portfolio management efforts by refining the collaborative learning strategies. In our opinion, there are other ways to support an instructor recording learners' behavior, analyzing behavior records, and making decisions. These additional guidelines include daybook, moderators' comments, and learners' questionnaires.

- A distance learning instructor can first design a daybook according the pedagogical issues that he/she wants to observe. One specific role of any learning activity should take the accountability to write down the events related to the items, which is defined by the instructor, in the daybook. Hence, a distance learning instructor can review the key processes of collaborative learning by reviewing the daybook that is written by the student with a specific role. Furthermore, the workload of the Web site manager is reduced by developing tools to help the instructor design the daybook instead of developing methodology to retrieve pedagogical meaning from learners' behavior records. Although we proposed in previous research a methodology to solve the learners' portfolios management issue by data cube and multidimensional analysis technology, the Web site manager can not master those skills over the short term.
- Moderators' comments can be used to indicate possible directions for behavior records analysis because a moderator will realize the problems in his/her group. A distance learning instructor can easily get the moderators' comments either by periodic email or a Web page for feedback. Hence, a distance learning instructor can avoid using the cube operations for multidimensional analysis but get the same requiring results.
- The results of learners' questionnaires can be used to verify moderators' comments. Furthermore, a distance learning instructor needs not reconstruct the collaborative learning processes before making decisions using the verification from learners' questionnaires results. Consequently, the instructor can free the Web site manager from the tedious tasks of computing cube visualization.

To sum up, an instructor may expect simply transfer existing collaborative learning strategy into the Web format and get similar effects on learners. From the perspective of the instructor, four features should be implemented on the Web, that is heterogeneous grouping, interdependence, individual accountability, and group processing. From the perspective of the Web-site manager, the collaborative learning strategies will involve technical requirements including activity, learning flow, and portfolio management. As in the examples mentioned above, an instructor can motivate learners' autonomic behavior by refining collaborative learning strategies to reduce classroom management efforts and technical requirements. Table 1 illustrates the relationships among learners' types of autonomic behavior, collaborative learning strategies, and ways to reduce technical requirements.

Technical requirements	Characteristics of collaborative learning strategy	Suggested refinements
Assign group	Heterogeneous grouping	Ranking
Assign role		Voting
Endow capability	Individual accountability	Accountability
Agenda	Interdependence	Notifying others
Automate agenda		Notified by others
Repository for behavior records	Group processing	Designing daybook and Appending daybook

Multidimensional analysis		Moderators' comments and learners' questionnaires

Table 1: Relationships between technical requirements and refinements of collaborative learning strategies.

Conclusions

This paper provides guidelines for a Web site manager to coordinate with a distance learning instructor for refining collaborative learning strategy. Consequently, the refined collaborative learning strategy will reduce the Web site manager's efforts in constructing the collaborative environment on the Web, and also reduce the distance learning instructor's efforts in managing the virtual classroom on the Web. This paper also briefly introduces the required technology and the method of constructing a Web-based collaborative learning system from our previous research. However, that purely technical solution for constructing Web-based collaborative learning environment would be a burden for the Web site manager due to its tedious technical tasks. Based on the characteristics of collaborative learning strategy, we present guidelines for refining collaborative learning strategies from our technical perspective. A collaborative learning example, the Team Game Tournament, is used to illustrate how the guidelines reduce the work needed for implementation. Hence, a distance learning instructor can use existing collaborative learning strategies and shape them to be suitable for implementation on the Web with relatively little effort. Most important of all, the guidelines indicate the directions for the instructor and Web site manager to achieve a common grand point of constructing a Web-based collaborative learning environment.

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Exploring Learning Potentials in Network-enhanced Learning Environment

Jihn-Chang J. Jehng
Institute of Human Resource Management, National Central University
Chung-Li, Taiwan 32054, Republic of China
E-mail:jehng@src.ncu.edu.tw

Abstract: This paper describes a study that examined how an Internet telecommunications tool, EdPsy Web, was used to support a pre-service teacher training course at the level of higher education has changed the quality of social and intellectual interactions that were different from what has happened in a traditional classroom setting. Findings of the study showed that students had seen the value of and demonstrated a positive attitude toward network learning after using Edpsy Web to create discourses. When assignments were delivered in an electronic form, students were motivated to see and compare what other students had accomplished and thus were more aware of what they had achieved. This network learning environment provides more opportunity for collaborative thinking and knowledge sharing. The analysis of electronic discourse explicitly demonstrated the multiple thread nature of electronic message interactions. In general, this network-enhanced classroom setting offered an alternative pattern of interaction which differed from the traditional face-to-face setting in some ways, but not all.

Introduction

There has been dynamic growth in the utilization of Internet telecommnications in the area of higher education. Researchers have indicated that the utilization of telecommunications technology in education will have significant impacts on instructional activities (Roberts, Blakeslee, Brown, & Lenk, 1990). When compared with traditional face-to-face communication, computer-mediated communication functions differently. This new medium has its own rules or patterns for managing temporal, spatial, and social aspects of interactions (Beals, 1992; Harasim, 1990; Kiesler, Siegel, & Mcauire, 1984). It allows for asynchronous interactions. Asynchonicity expands user control over the time of interaction, thereby increasing the time available to read or re-read a message in order to carefully formulate a proper response, the result being a more fruitful and thoughtful discussion around a number of interrelated topics. The record of dialogue interactions can be a rich source of ideas setting the stage for knowledge building activities. Furthermore, the place-independent feature of the telecommunications-based learning environment has the capability of linking persons from different locations for the purpose of communication. Compared to traditional face-to-face communication, asynchronous network communication operates in the absence of social context cues, such as facial expressions, eye contact, and voice intonation. Participants must make their communication clear and understandable. Transcripts of network conversations provide an explicit record of interactions for users to interpret and trace the progress of intellectual interactions. Finally, the telecommunications-based learning environment tends to reduce differences in social status and prestige, thereby providing a more egalitarian context for social interactions. This may lead to more open and spontaneous participantion. Based on its powerful capabilities of information management and unique communicative style, the telecommunications-based learning environment may have different impacts on student learning and motivation.

Facilitating collaborative interactions through computer network

Recent studies on human cognition have viewed learners as agents in a distributed cognitve system which includes physical objects, symbolic representations, people in social relationships, and features in physical situations, all of which play a part in the accomplishment of cognitive activities (Oshima, Scardamalia, & Breiter, 1996; Pea, 1993). This view of human cognition implies that learning no longer belongs to an individual enterprise, but to a joint effort made by learners and their surrounding environment. Theoretically, the classroom can be regarded as a distributed system where students, teachers, symbols and artifacts interact. The classroom discouse provides a collective zone of proximal development that supports student learning (Brown, Ash, Rutherland, Nakagawa, Gordon, & Campione, 1992).

Researchers have recognized that tools offered by computer-mediated communication (CMC) not only can increase the learner's access to information but can also faciliate knowledge building activities. Studies in the Internet-infused learning environment indicated that the utilization of telecommunication tools in teaching may influence student learning regarding science (Linn & Songer, 1991; Songer, 1996). The telecommunication-based learning environment provides a chance for students to get access to real-time resources and firsthand information. Students have greater opportunity to participate in dialogue with distributed peers. The flux of personal experiences, scientific information and expert knowledge infused into the learning environment has the potential to help students develop a rich explanatory base for learning and application of knowledge. Studies have shown that students in the network learning environment demonstrated significantly greater understanding of scientific concepts than did students in traditional classroom settings (Songer, 1996), greater motivation to interact and share ideas with other students (Ruberg, Moore, & Taylor, 1996), and more thoughtful and self-regulatory learning behaviors (Scardamalia & Bereiter, 1991).

The telecommunications tool has demonstrated potential as a medium for sustaining and expanding zones of proximal development, freeing teachers from the burden of being the sole source for transmitting knowledge and allowing the learning community to extend beyond the boundary of classroom. Studies have indicated that telecommunications techonology can faciliate thinking and help shape thought (Brown et al., 1992; Scardamalia & Breiter, 1991). Through the computer-mediated learning environment, participatory activities in which students could practice cognitive strategies, communicate understanding, clarify their positions and develop ideas with their partners are more likely to be facilitated.

Previous research made a claim that the telecommunications technology could be a powerful tool for collaborative interactions and for building a community of learners, however, few demonstrated how the mechanism underlying the process of collaborative interactions could provide opportunities to facilitate learning, and how participants were motivated to learn in the computer network environment. In viewing collaborative interactions in the telecommunications-based learning environment are essential for students to develop their understanding and experience, this research attempted to explore two problems, namely (a) did a network-enhanced classroon setting actually motivate students to interact and share knowledge? and (b) did distinct learning behaviors exhibited by students exist in a network-enhanced classroon setting? Answers to these two problems could help us not only understand how a telecommunications-based learning environment facilitates group interaction and collective knowledge building, but help develop an effective learning environment as well.

Method

The study was conducted in an instructional setting where college students interacted and discussed educational psychology problems with an Internet tool. Three key evaluation methodologies, survey, discouse analysis and message flow analysis, were used to investigate social and intellectual interactions and assess the educational value of this network-enhanced learning environment.

Participating subjects

The subjects were 58 students registered at the National Central University, Taiwan. They were from different departments and participated in an educational psychology course designed as one of the prerequisites for training pre-service teachers. There were 22 males and 36 females.

The network-enhanced learning environment

An Internet telecommunications tool called EdPsy Web was used in this study. The role and purpose of this Internet tool was not to replace but to enhance and transform existing instructional activities into more powerful ones. There were ten functions provided by Edpsy Web (Figure 1).

Participant information. Students could access information about their teacher by clicking the "Know your Teacher" button. Information regarding the teacher's educational backgrounds, research activities, and publications were avabilable for the students' reference. The tool also allowed students to access fellow students' personal information through the "Know your Classmates" button.

Instructional activities. An on-line course syllabus was available for students to consult at any time through the "Course Syllabus" button. The system also provided an on-line discussion function through the "On-line Problem Solving" button. By using this button, students could post ideas and peruse other students' opinions regarding a particular problem or issue. All written assignments could be delivered to and evaluated by the teacher electronically through the "Assignments" button. Students could use this function to see the teacher's evaluative comments as well as other students' works. The "Exchange Idea" button allowed students to exchange ideas regarding the course. The "Reference" button provided lists of reference materials relevant to the course content, such as books, journals, and brief introductions of preeminent educational psychologists.

Instructional administration. Activities regarding the course was announced and accessed through the "Announcements" button. Students could check their grades by clicking the "Check your Performance" button. Finally, students could send their suggestions regarding the course through the "Your suggestions" button.

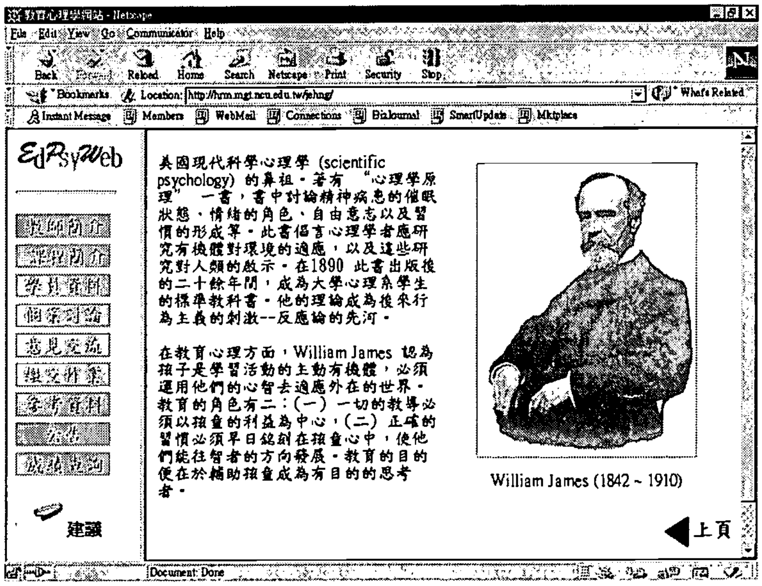

Figure 1: The Edpsy Web Internet tool.

Procedure

In order to have this functioning network community implemented successfully, the teacher managed a reliable computer network for students access and designed well-specified tasks to be accomplished by students (Riel & Levin, 1985). At the beginning of the semester, the teacher spent one week teaching students to learn to use Edpsy Web. Students were requested to enter their personal information into the system and all written assignments were transmitted to the teacher electronically.

After the mid-term exam, two on-line problem solving activities were arranged and each one lasted two weeks. Problems were posted electronically. Students were required to post their ideas and discuss solutions to the problems with their classmates using this Internet tool. They were allowed to collect information from different sources. The teacher did not take any action to moderate or intervene in student discussions. The two activities were held in two different formats commonly used in traditional classroom settings. Firstly students were requested to pose their opinions individually. The problem contained the issue of whether speed reading can really assist students to study and acquire knowledge. Secondly students were requested to study in a group. Six groups were formed and each was required to figure out opinions before posting it on EdPsy Web. The problem contained the issue of whether an objective evaluation systems could be developed to assess student learning in an ill-structured domain, such as history, geography and civics.

Data source

A post-course questionnaire was developed to assess student attitudes toward this learning experience. The questionnaire contained 21 statements with a five-point Likert scale in which 1 indicated strong disagreement, 3 neutral and 5 strong agreement. The questionnaire also included an open-ended question which would solicit the students specific opinions about EdPsy Web. Fifteen senior students who needed to participate in graduation exams dropped the second on-line problem solving activity and did not complete the questionnaire.

All student on-line behaviors were recorded by Edpsy Web, including the time and frequency they logged into the system. Students' written assignments and their ideas during the two on-line problem solving activities were all collected by the system.

Analysis and results

In response to the two research problems addressed above, our data analysis focused on four questions related to emergent learning in the Edpsy Web learning environment: (a) Did students hold a positive attitude toward learning with Edpsy Web? (b) Were students of different genders motivated differently to use Edpsy Web in relation to their prior Internet experience? (c) Did students demonstrate particular learning behaviors during the on-line problem solving activities with Edpsy Web? (d) Did on-line problem solving activities impact their understanding specific learning issues related to educational psychology?

Student attitudes and the motivational differences

Statistical analyses of students' responses on the post-course questionnaire showed that mean scores of 21 items were above 3, indicating that in many circumstances students had a positive attitude toward learning with Edpsy Web. An 2×2 ANOVA analysis of student responses was made along with two demographic variables: gender and prior Internet experience (Table 2). Results indicated that the two variables significantly determined the students' attitude toward Edpsy Web. Students who were frequent Internet users (at least 3 hours a week) tended to be more motivated and had a more positive attitude toward learning with Edpsy Web than infrequent ones (less than 3 hours a week), $F = 5.49$, $p < .05$. Males tended to have a more positive attitude than females, $F = 8.24$, $p < .05$. There was an interaction effect between the gender and the prior Internet experience variable, $F = 7.60$, $p < .05$. Females who were frequent users tended to have a more positive attitude than female infrequent users. No significant difference in attitude between male frequent and infrequent users.

		Gender	
		Male students	Female student
Internet	More than 3 hrs per week	86.09* (9.83)	94.00 (3.61)
Experience	Less than 3 hrs per week	86.63(11.72)	80.69 (11.68)

Note. Mean scores with standard deviation in parenthesis.

Table 2: Student attitudes toward learning with EdPsy Web as a function of their gender and Internet experience.

Student on-line learning behaviors

Analysis of login data can help recognize student on-line learning behaviors. The 58 students had logged into Edpsy Web for more than 950 times across 10 weeks of use. Three hundred and ninety-eight logins were clustered during the two on-line problem solving activities. Eighty-three messages were posted across these two on-line activities, of which 80 individual messages were for the first activity (average 1.38 per person) and 13 group messages for the second (average 2.17 per group). For the first activity, all students posted messages.

Impacts of on-line problem solving activities

In order to explore how the on-line problem solving activities impact student learning, transcripts of all written messages were analyzed and an attempt was made to draw up a typology of electronic messages related to the educational values they displayed. The analysis of transcripts of the first on-line problem solving activity indicated that the independence and initiative of the students in searching out different sources of information to develop their ideas during the on-line discussion. For example, one male student wrote a message drawn from his personal learning experience about speed reading:

> "... I received speed reading training while I was preparing the national extrance exam during the senior high. I really feel that speed reading training helps me read faster, but it may overlook comprehension. I also feel that I have acquired lots of knowledge about study skills from the training. Although speed reading skill can be acquired within a short period of time, but you still need to keep practicing in order to maintain the skill. In my experience, a speed reading training course provides different reading skills such as skimming by gaining control of eye movements, reading without subvocalizing, range reading technique, meta guiding with photographic memory, mind mapping, etc..."

Some of the students wrote messages to express their ideas based on their knowledge learned from the textbook. Part of them drew information from what they had learned in order to defend why speed reading can really work to facilitate quick learning of text material. Part of them drew theories to deprecate the educational value of speed reading. For example, a student drew a memory theory explaining why speed reading can not facilitate deep learning and processing information:

> "...In 1972, Craik and Lockhart proposed the theory of levels of processing in that information can be processed in human memory at either the syntactic level or the semantic level. Processing information at the syntactic level becomes superficial processing. It is difficult to keep information that is processsed at the syntactic level in the memory for a longer period of time for later retrieval. Speed reading training only

teaches students how to draw quick attention to learning materials, but does not allow time for deep information processing. Therefore, speed reading does not help individuals to retain information in the memory for a longer period of time..."

Several students got information from materials outside the course or from the Internet. The following excerpts indicated that students drew information from the Internet:

> "... Many people believe that speed reading is simply skimming or scanning materials, and that reading material slowly is the best way to subsume printed information. Such an assumption is incorrect. Skimming may be appropriate for reading new material. Surprisingly, the more quickily you read, the better you can memorize things. But it is important to comprehend what you read.
> One efficient way to read material is mind-mapping, a multi-dimentional mnemonic, in that you make use of the structure of paragraphs and their placment in the text to improve your reading efficiency, but not each word literally. For example, you just make up a memory word for the main theme of each paragraph and relate them. Reading paragraph by paragraph easily helps you understand. It is not helpful in increasing comprehension when you just read material word by word... Resources: http://www.study.com.tw/txt3.htm...."

Analysis of transcripts also found that there were no particular persons who dominated or took the lead during the dicussion. The message flow analysis indicated the number of messages issued and the number of student logins per day were significantly correlated, r = 81, $p < .000$. Interestingly, the number of student logins and messages issued dramatically jumped each Tuesday when the course was held. A similar pattern repeated in the second week of on-line activity. Obviously, the ebb and flow of messages corresponded to the ebb and flow of school activity.

Previous research on on-line discussion indicated at least three types of roles could be identified when tracing specific themes as discussants wove their way through messages: idea introducer, idea developer, idea synthesizer (Vallee, Johansen, Lipinski, & Wilson, 1974). Based on this idea, an analysis of the major role that each message played was made for the first on-line activity. As Figure 2 shows, at the initial stage of activity, students' messages mainly dealt with idea introduction and development. Some of the students' messages introduced about what speed reading is. Other students then drew certain psychological theories from textbooks to support or deprecate previously initiated ideas. As more new ideas were introduced, more students began to add information to elaborate upon those ideas during the middle stages of the activity. Almost 60% of the major role played by messages as an idea developer from day 4 to day 12. The role of idea synthesizer became more apparent at the end of the activity. As shown in Figure 2, a map was plotted. Messages sharing the same theme were clustered around each day and those clusters containing messages with the same theme were linked with lines across the duration of problem solving activity. A main idea could be elaborated into more specific ideas which later may became main ideas. The map demonstrated the "multiple thread" nature of electronic message interactions and that different ideas were being pursued in parallel (Quinn, Mehan, Levin, & Black, 1983).

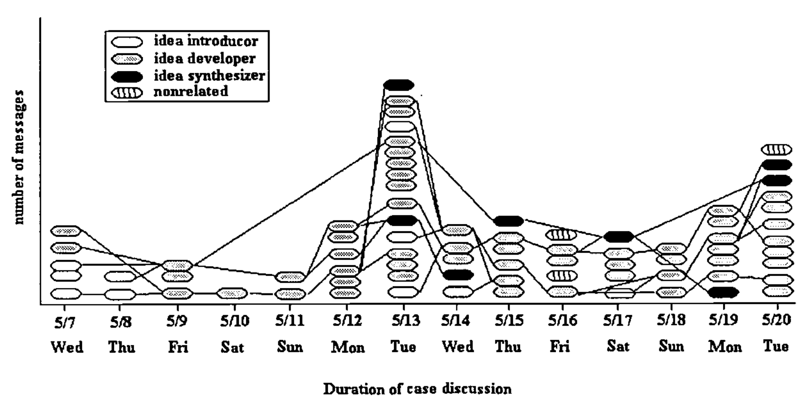

Figure 2: The multi-thread characteristics of electronic messages flow in the first problem solving task.

Discussion

Findings of the study indicated that students had a positive attitude toward network learning after they had used the Internet tool, EdPsy Web, to assist learning, social interactions, group problem solving, assisgnment delivery, and knowledge sharing. Students were highly motivated to have a system that allowed them to send their assignments electronically, to read their teacher's evaluative comments, and to compare other students' works in an electronic form. In most traditional classroom settings, students usually submit assignments to their teachers physically, and receive feedbacks from them without having opportunity to understand what they had acomplished in comparison with other students. In EdPsy Web, however, students had opportunty to see and compare what other students had performed so that they could be more sensitive to what they had achieved. This provided opportunity for students to develop a metacognitive skill to self-monitor and self-evaluate their learning behaviors which may lead to a more effective process of knowledge acquisition.

Results of this study support the hypothesis that two variables, gender and prior Internet experience, are significantly related to attitude toward this Internet tool. Since boys are exposed to computers at an earlier age and more offen than girls, they have more opportunity to use the Internet. Therefore, they are more apt to take advantage of the tool to learn. With less time exposure to the Internet, most female students were not familiar with the functions afforded by the tool so they did not fully appreciate it nor did they take advantage of it. This may have a bearing on male and female students' attitudes toward the tool.

Analysis of the on-line problem solving activity indicated that students could fully take advantage of the telecommunications tool to generate and express their ideas. According to results of our survey, students preferred the on-line problem solving activity to be held on an individual basis rather than in a group. This may indicate that students were motivated to use the tool to express their own thoughts and learned with it individually. The data explicitly showed that there was no group leader to dominate and take the lead during the on-line learning activity and all students posted their messages. Evidently, the network learning environment provided a more egalitarian climate for social and intellectual interaction.

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AN ON-LINE COLLABORATION: EXPLORING THE FUTURE OF OUR PLANET THROUGH SCIENCE AND FANTASY

Nada L. Mach, Ph.D.
Teacher Education Department
California State University, Dominguez Hills
United States
nmach@dhvx20.csudh.edu

Abstract: An interdisciplinary on-line project, connecting two high schools from diverse school districts, positively influenced student attitudes and resulted in a collaborative publication on the World Wide Web. Comparisons of the frequency distributions resulting from administration of an Attitude Survey in the form of a Likert-type scale revealed increases in positive student attitudes toward English and science, connecting the disciplines, technology, and collaborating with students of different socioeconomic and ethnic groups. Barriers to other formal statistical analyses of the data included: the unforeseen changes in population of the two classes; small sample size; and insurmountable technological problems in one of the schools. Further research is recommended to examine similar interventions.

Introduction

Making high school education work in a changing culture necessitates linking learning to life. Because of the rise in the number of problems associated with urban high schools, such as gang activity and difficulties in dealing with increasingly diverse ethnic and linguistic school populations, high school teachers have become aware of the importance of making school relevant to students' lives. Further, they are starting to recognize the need to emphasize an interdisciplinary curriculum organized around questions students consider important, rather than a strictly subject-based curriculum. A number of innovations in high school curricula integrate subject areas to make "...connections between bits of knowledge and skills from different realms, organized around [such] focusing questions..." (Clark & Agne, 1997, p. xv) as

- How does a civilization come into being?
- What does it take to solve a major environmental problem?
- What do I need to know to thrive in a technological society? (Clark & Agne, 1997, p. xv)

Students must link facts and ideas from disciplines in order to answer these questions, as well as use higher-order thinking skills, and apply abstract ideas to real problems in real situations.

In attempting to explore these and other higher order questions, the infusion of computer technology into the classroom can enhance classroom communications and resources. Computer-mediated communication, in particular, can "...virtually bring the world into the classroom, engage students in collaborative processes, enable them to access experts worldwide, and to make each student an active member of the international community." (Schrum & Berenfeld, 1997, p. 28).

The social, as well as academic benefits of using computer-mediated communication are abundant. Social barriers break down, as students from different communities, cultures, and socioeconomic classes collaborate with each other to discover answers to such important questions.

The Project

A grant from the Corporation for Public Broadcasting (1997) to encourage the infusion of technology into the curriculum enabled the collaboration among the School of Education at California State University, Dominguez Hills, and two high schools in two different districts during the 1997-98 school year. Students from the tenth-grade "Integrated Science" class at West Torrance High School in the Torrance Unified School District, collaborated with eleventh-grade English students at Manual Arts High School in the Los Angeles Unified School District, on an interdisciplinary problem-based project that involved research, inter-school communication via e-mail, creative production and publication on the World Wide Web, as well as social action.

The goal of the project was to involve students and teachers in interdisciplinary teaming and infusing computer technology into the high school curriculum. Technology provided the students with increased motivation, as they researched and wrote for a wide audience (on the Internet), and examined issues of scientific and social import. Teachers used constructivist methods that empowered their students, and provided exemplary models to be used with university credential candidates enrolled in Secondary Interdisciplinary Methods courses and/or Educational Technology courses.

The high school students, from two very socioeconomically and ethnically different schools, collaborated with one another on-line to write and do research, in order to build a home page that provided a forum for information and creative writing about scientific issues of import to humankind.

Manual Arts High School is located in the center of Los Angeles, commonly referred to as the "inner city," and West Torrance High School is located in a suburb adjacent to the city of Los Angeles. Both are considered ethnically diverse, though with different ethnic populations; Manual Arts High School is primarily Latino and Black, and West Torrance, primarily Asian and Caucasian. There is a large gap between the schools with respect to students' socioeconomic backgrounds.

The following were the objectives in the year-long project:

- to increase students' awareness and understanding of the world around them;
- to make students cognizant of the issues arising from the environment and scientific discoveries, as well as their ethical and moral implications;
- to stimulate students to explore possible solutions to moral dilemmas posed by the issues;
- to encourage students to use concepts inherent in real issues to write fiction and poetry;
- to improve students' research and writing skills;
- to motivate students to do further reading of science fiction, poetry, and material concerning the issues;
- to promote inter-school cooperation;
- to bridge the gap between socioeconomically and ethnically diverse student populations;
- to involve students, teachers, and pre-service teachers in research which makes use of computers, CD-ROMs, and the World Wide Web;
- to update equipment at both schools to complete the project;
- To stimulate discussion, further reading and exploration of social action by students and others accessing the resulting Web site; and
- To create a constructivist learning environment that supports inquiry, interdisciplinary teaming, and the integration of technology into the curriculum.

As a first step, both classes took an attitude survey (see Tab. 1) at the beginning of the project to determine how they felt about several things: studying English and science; using technology; and working with students who were different from themselves. This survey was to be administered again at the very end of the project to determine if there were any significant changes.

Next, the Integrated Science class did research both in traditional methods and on the World Wide Web to write scientific briefs on issues related to their studies, issues that have moral and ethical implications, that involve conflict, and are of serious import to humankind. Although originally conceived to involve a biology class, the issues in integrated science broadened the scope of possibilities. After brainstorming during the first few weeks of school, the Science students came up with the following:

1. Space exploration
    - Mir Space station (out of control, or having alien contact)
    - Mars Lander (discovery of life form)
    - People living in space (stations)
    - Asteroid impact Specific environmental topics
    - Effects of El Nino
    - Global warming
    - Nuclear war or nuclear accident at San Onofre
    - Ozone depletion
    - Effects of a "supernova" on Earth
2. Animals
    - Communication with dolphins
    - Communication with apes and chimpanzees
    - Effects of solar flares on the Earth

- Another ice age

3. Human physiology
   - Ebola virus
   - Curing cancer
   - diet medications

Attitude Survey
Directions: For each of the items below, write the number that best describes your opinions. There are no right or wrong answers; we are merely interested in how high school students feel about these issues. • Not at all (1) • A little (2) • Somewhat (3) • Quite a bit (4) • Very much (5)

Category	*Item*
The Disciplines	1. I think English and science are two subjects that relate to each other. 2. I think English is an important subject. 3. I enjoy English class. 4. I think science is an important subject. 5. I enjoy science classes. 6. School would make more sense if teachers from different subjects would work together to plan projects for the students. 7. Teachers from different subjects should work together to plan student projects so that the students could make more connections between the different topics they are studying. 8. Research/library skills are important in studying science. 9. Reading is important in studying science. 10. Writing is important in studying science. 11. Word processing is an important skill in studying science.
Technology	5. I feel comfortable working with computers. 6. I feel comfortable exploring the Internet/World Wide Web. 7. I feel comfortable doing using e-mail. 8. I think learning to use technology is important. 9. I think technology is useful. 10. I think learning how to communicate via e-mail is important. 11. I think learning to do teleconferencing is important. 12. I think communicating via e-mail is a useful skill. 13. I think teleconferencing is a useful skill. 14. I like working with computers/technology while I learn science and/or English.
Work Situations	6. I feel comfortable working alone on assignments in class. 7. I feel comfortable working on assignments in a small group in class. 8. I feel comfortable working with students from another class in school. 9. I feel comfortable working with students from another school. 10. I feel comfortable working with students from other neighborhoods. 11. I feel comfortable working with students from other geographical areas. 12. I feel comfortable working with students from other races and/or cultures.

Table 1: Attitude Survey

The science students then sent, via e-mail, the "scientific briefs"(see Tab. 2), which were uniform in content, to the students in the "Contemporary Composition" class at Manual Arts High School. Again through email and one videoconference (which unfortunately had to be aborted due to lack of appropriate wiring) students from both classes attempted to explore solutions to the issues, possible avenues for social action, and "what if" scenarios. The students in the English class then took the issues in the "scientific briefs," and created science fiction short stories based upon them. In preparation for the creative writing, English students did their own research, reading works of science fiction authors who have dealt with such issues.

English students edited the articles to be published on the Web site for mechanical and organizational content. Similarly, the science students edited the English students' stories for scientific accuracy. Both classes then published their works on the Internet, on a Web site provided by Manual Arts High School. After the publication of the first issue, the intent was originally to solicit contributions from students at other schools for contributions to other issues. Unfortunately, the actual amount time both classes needed to complete the steps in the project exceeded the amount estimated; therefore only the initial round of stories was published.

Scientific Brief
Issue: ____________________ Explain why this topic is an issue:
Explain the controversy over this issue:
Background: Give a brief history of this issue (When and where did it become an issue? Facts leading up the present situation.)
Current status of issue: What has been accomplished? Where are we now in relationship to this issue? Has any progress been made? What?
Possible solution(s) to this issue: ________
Suggest a "what if" for a possible story, poem, or play about this issue:

Table 2: Template for Scientific Briefs

The project Web site is *http://www.lausd.k12.ca.us/Manual_Arts_HS/CPB/Science_Fantasy.html.* A Hyperlink to the project web site is also available from the author's Home Page at California State University, Dominguez Hills, at *http://www.csudh.edu/soe/faculty/nmach.htm.*

As the culminating event, in late May there was a face-to-face meeting of both classes, together with their teachers and the university sponsor at a luncheon at California State University, Dominguez Hills. A guest speaker, Mr. Scott Greenberg, got the students involved in an interactive writing workshop. Mr. Greenberg, is a humorist, screenwriter, speaker and leadership consultant who has inspired young people across the country to overcome obstacles and achieve their dreams. Students met at the University Student Union, where they mingled over lunch. They then were put into heterogeneously composed groups in order to participate in the writing workshop.

At the end of the year, both classes again completed the attitude survey (see Tab. 1) to see if there had been any significant change in any of the variables (see Fig. 1).

Findings

In addition to administering the Attitude Survey (Tab.1) at both the beginning and end of the school year, the teachers compared student work, student journals and other classwork from fall to spring, for improved factual content and writing skills. Both high school teachers also informally compared the participating classes to their other classes with regard to student motivation and involvement, on such variables as attendance; quality of work submitted (content/writing skills); and participation in projects.

Results of the Attitude Survey are indicated in the charts in Figure 1, below, and at *http://www.csudh.edu/soe/faculty/NmachAACE/figure3.html.* Although they were from two different schools and two different subjects, the two classes were combined due to the small number of students in the sample, and for purposes of comparison between pre- and post-project attitudes. There were some students who took only the pre-test, but for one reason or another did not continue to participate in the project; they therefore were not included in the post-test. *In toto*, 39 students completed the pre-test and 33 completed the post-test. The author therefore looked at frequency distributions in the form of percentages of students who responded with specific ratings on a one-to-five point Likert scale to the various questions.

Some interesting Pre- and Post-project differences emerged when comparing the mean percentages of students' ratings in the area of technology in general. When all the items were combined in this area, numbers of students using a rating of "5" rose slightly (from 44% to 48%), though they were initially somewhat high. "Comfort Level with Computers" also showed a rise in number of students giving ratings of "4"and "5," with a corresponding decrease in those with ratings of "1," "2," and "3." Ratings of "4" for this question rose from 41% to 48%, and ratings of "5" rose from 18% to 30%. The increase is similar when looking at "Comfort Level Using E-mail," with those rating it with "5" rising from 33% to 45%. In other areas, numbers of students selecting "4" and "5" combined, for attitudes toward the disciplines, in this case English and science, as well as interdisciplinary work, showed a slight increase, rising from 57% to 61%. Similarly, more students selected these same ratings for attitudes toward working with others, particularly those from other ethnic and socioeconomic groups, with those selecting "4" or "5" combined rising from 58% to 64%.

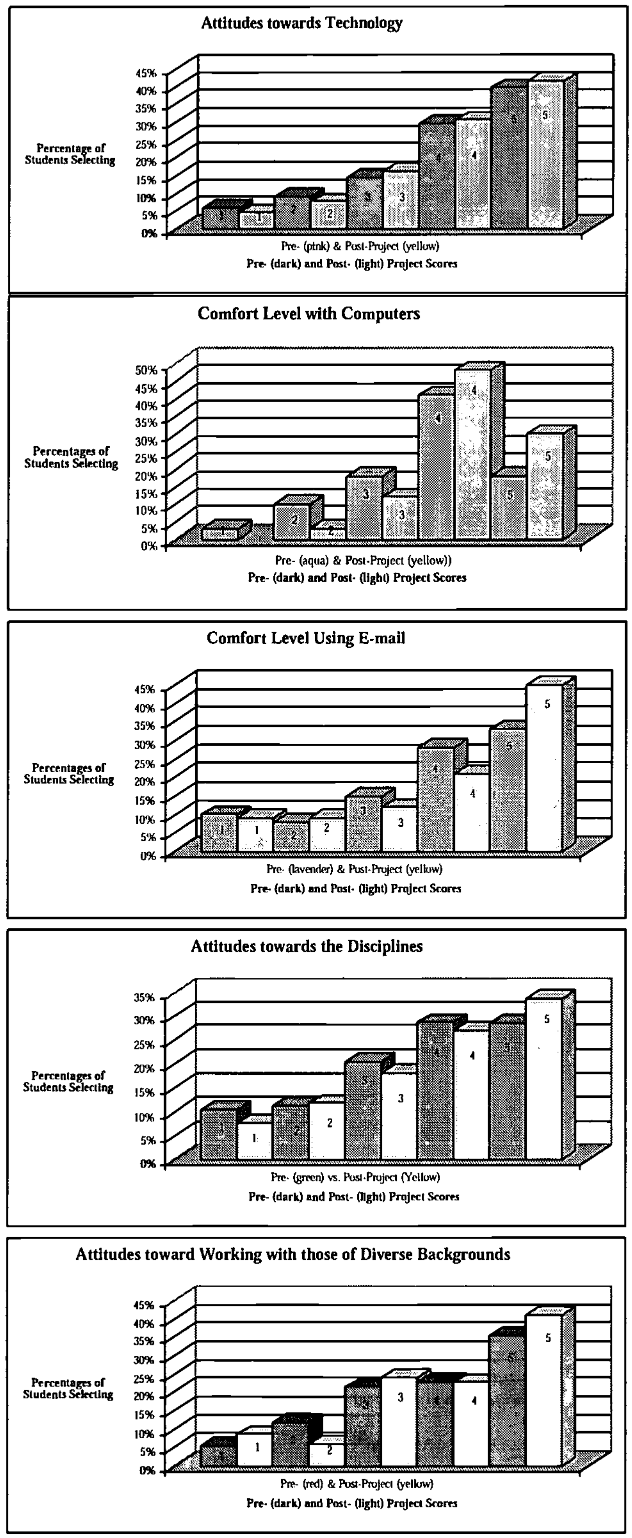

Figure 3:Bar graphs Depicting Pre- vs. Post-Project Attitudes – percentages of students responding with #1-5 on Attitude Survey (in color at *http://www.csudh.edu/soe/faculty/NmachAACE/figure3.html*)

Informal feedback from students was highly positive. Students came away from the face-to-face meeting with changed opinions of the ethnically and socioeconomically different groups than they had originally held, and increased levels of self esteem. One student actually commented that the guest speaker at the face-to-face meeting "changed her life." Both teachers in the two high schools reported higher than normal attendance on the days students were to work on the project, particularly on days when e-mail and an attempted video conference were to take place. Teachers noticed slight increases in student grades when compared with their other classes, but also a tremendous increase in student motivation, as evidenced by student attendance, small and large group participation, and submission of classwork.

Conclusions

In sum, it appears that in this project, electronic collaboration positively affected student attitudes toward English and science, connecting the disciplines, technology, and collaborating with students of different socioeconomic and ethnic groups. The increases in attitude ratings were most evident at the higher end for most categories, strongly suggesting noticeable differences in those areas. On-line communication is, after all, both color- gender-blind, thus capable of dispelling stereotypes about students from other areas, other ethnic and socioeconomic groups. To the students, the meaningful real-world connections of an interdisciplinary project, as well as the knowledge that their work would be published on a Web site, motivated them to apply themselves to the study of both English and science, and positively influenced their ability and comfort level in using technology.

Unfortunately, certain problems prevented the emergence of statistically significant findings, most notably: (1) the size differences between pre-and post-test populations of the two classes prevented stricter comparisons using raw data and t-tests to prove significance; (2) the small sample precluded making generalizations from the data collected; and (3) one school was not fully wired for Internet access, thus making it difficult to carry out the teleconference successfully.

It was ironic that it was the suburban school that was not fully wired, while the "inner city" school" was extremely well equipped. This is the reverse of what would be expected, since the inequities in school funding usually expected in the two types of schools ("inner city" *vs.* "suburban") usually have repercussions in their technological sophistication. Our "suburban" school, however, may not be representative, since it has a large working class population that has been rather conservative in defeating school bond issues. Similarly, our "inner city" school may not typify the inner city schools in Los Angeles, because of the unusual number of technology grants it has received.

Further research, with improved experimental design in such areas as using a larger population of students, comparisons with control groups and stricter controls on administration of attitude surveys, would increase the generalizability of results.

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Using Analogy to Build Conceptual Understanding of Multimedia Environments

Paula Roberts
Communication and Information Studies
University of South Australia
paula.roberts@unisa.edu.au

Abstract: The web-like nature of multimedia projects differs significantly from traditional linear environments, and navigation in this new terrain relies heavily on abstract thinking, involving spatial ability. This study examined the use of a familiar analogy in assisting the conceptual understanding of hypertext and multimedia environments. The outcomes of this research suggest that familiar analogies may enhance perceptual understanding in computing novices, and encourage these students' use of the new media for academic writing.

1. Introduction

Research has shown that the use of word processors in student essay writing in secondary and higher education has brought minimal benefit, and has done little to aid the planning and revision of texts. The reasons lie chiefly in the computing technology itself. When composing text on the computer, the vision of the writing is limited to the current screen view, and preceding passages are obscured. The scrolling back and forth required to locate an earlier sentence or paragraph creates in many writers a form of cognitive motion sickness. More serious still, the writer has little chance of developing a conceptual map of the whole piece, leading to what has been described as a 'text sense' problem; that is, a lack of 'knowing' or recalling the text brought about by the difficulty of gaining a 'global perspective' of a piece of writing which is essential for its structural reform (Eklundh 1990).

These difficulties have caused many students to spurn the use of computers as writing tools, and they persist in writing their first and subsequent drafts by hand, and then use a word processor only to produce a final version of their writing. Thus the revision of previous drafts remains a surface, cosmetic process, most often without structural alterations, despite the obvious usefulness of the word processor's 'cut and paste' facilities.

Other strands of writing research have led to the design of hypertext systems which assist the cognitive mapping of writing from source documents, and which allow the planning stage of writing to proceed in non-linear fashion. However useful these systems may be, the movement from linear computer environments to the web-like, branching structures of hypertext and multimedia formats requires a conceptual leap in cognition which depends to a great extent on spatial ability. This facet of human cognition is under-developed in many students (females in particular) due to differential socialization and mathematical experiences, and is an anomaly which apparently disappears with practice (Hyde et al. 1990).

Computing educators, who understandably are caught up in the excitement of the educative potential of multimedia formats, must not take for granted a student's easy passage from the old and familiar linear formats of reading and writing to these new, non-linear presentations of information. This paper describes how the use of a familiar analogy, in this case, the format of information presentation in popular newsmagazines, has assisted students in achieving the conceptual transition from the linear to the non-linear, and, at the same time, has both improved student academic writing, and revealed to the students the narrative potential of writing in multimedia formats.

2. The use of analogy in the conceptual understanding of computer systems

Learning with computers often creates problems for students inexperienced in their use, and anxiety can develop into avoidance (Harrington et al. 1990). Familiar analogies have been used by computer designers to reduce anxiety and to increase the 'user-friendliness' of their product, for example, Apple's (and now Windows') 'drag and drop', icon-based filing system for electronic documents uses familiar analogies, in which the user drags a file to a familiar folder icon, or to a rubbish bin icon, an arrangement which is far easier to understand and use than the former PC filing method of creating directories and sub-directories.

Analogical reasoning has a long history in human cognition and scientific thought. Gentner & Jeziorski (1993) define the central idea of analogy as the mapping of knowledge from one domain (the base) into another (the target). However, in processing analogy, people implicitly focus on certain similarities and discard others. These writers cite a bright student reading the analogy, 'a cell is like a factory', and suggest she is unlikely to see a cell as constructed of masonry and steel, but more likely will consider the similarities of the processes of factories and cells, that is, the intake of resources to maintain operations and generate products.

The research literature supports the use of familiar analogies in promoting understanding of new concepts especially in novices (Hesse & Klecha 1990). Analogies act as 'advance organizers' which allow learners to 'map the new' on to familiar material, although there is a danger that the particular quality of an analogy may bias how new material is understood, and the transferability of learning may also be impeded if the analogy is insufficiently transparent.

Russon, et al. (1994) cite a small body of work relating to the use of analogies in computer education for novice learners, including Beard, et al. (1987) who found that paperwork analogies were helpful in students' understanding of simple database retrieval. Russon and his colleagues (1994) discovered that changing one aspect of computer exposure, in this case the way computer material is taught by the use of analogy, had beneficial effect on skill acquisition and the development of confidence in computer novices. These various writers identify the value of analogies in assisting learners to link new with familiar material, thereby fostering both a sense of relevance and reducing anxiety.

3. Multimedia: a conceptual approach

Douglas (1993) notes that, as an environment for reading and writing, hypertext represents an intriguing and compelling paradox, for while its content looks like the printed word, its technological apparatus places the printed word in an environment almost free of the physical constraints and characteristics traditionally associated with printed text. The problem of how the unfamiliar structure of hypertext might best be conveyed to students as they explore different ways of writing with computers suggests the need for a familiar analogy to aid the conceptual understanding of hypertext and multimedia formats.

The genre of newsmagazine writing presents itself as a powerful analogy (and conceptual tool) for understanding the complexities of these new writing environments, as well as their potential to revolutionise our traditional notions of text. Newsmagazines represent a new yet familiar form of electronic writing. Formatted with page layout software similar to that used by student writers, their structure and visual presentation allows easy analysis of the text. That these magazines are composed and typeset centrally, and then transmitted electronically to regional areas of the world for the addition of local content, is compatible with students' understanding of online communications and co-operative writing. However, it is these magazines' style of information presentation which makes them an even more effective analogy for students in their understanding of new ways of writing, and reading electronically.

The newsmagazine presents its information in fragmented but connected pieces, and departs from a text-only approach to communicate with various formats of text and graphics, a visual variety which has been created with the purpose of gaining attention and facilitating understanding. Designed to be read in trains and buses as much as in lounge rooms, the newsmagazine allows readers different entry and exit points from its stories by segmenting them into main text and commentaries. This, of course, is the nature of hypertext and multimedia presentations of information, where the reader has a similar choice.

In newsmagazines, these commentaries which exploit the facilities of page layout software, exist on a different narrative level than the main text, thus creating an illusion of web-like connections with the main story. As such, these 'layered' texts represent a powerful analogy, which aids students' understanding of the electronic construction of hypertext and multimedia environments, as well as the opportunities they present for the reader to depart from the traditional linear path of reading. These facets of newsmagazines were used as conceptual tools in the study outlined below.

4. The Study

This paper describes a study of Arts undergraduates at the University of South Australia, who, in writing with page layout software, moved beyond mere page design to exploit this software's potential for displaying the 'layering' of information. Using a newsmagazine style of writing, typified, for example, by *Time* and *Newsweek* magazines, the students took a word processed story and transformed it into a layered text which simulated a hypertext or multimedia environment.

The news-magazine genre is familar to most students who are avid consumers of magazines. *Time* and *Newsweek* magazines are known to students, (if not as well as the more 'pop culture' adolescent magazines), and are readily available. At the start of the study, the unique features of these magazines' presentation of information were analysed. For example, in a recent story on heart attacks, the *Time* magazine writers departed from their main theme of the incidence and cost to society of the prevalence of heart disease, to create various subthemes, (or layers), to the main story. One such subtheme was a list of recovery chances, based on the closeness to medical assistance at the onset of the attack. Another was a commentary on risk factors in the prevalence of heart disease, related to personality-typed individuals, while another significant section was an interview with patients who had made an excellent recovery after suffering a heart attack.

In *Time* magazine, through desktop publishing techniques, the themes in this article had been integrated on the same or adjoining pages, but were separated by textual and graphical means, such as the main columned text's weaving its way through 'islands' created by graphics and photographs, and by the separate, coloured and boxed panels of text which contained the subthemes. Here was choice for the reader, either to follow the main text through the pages to its conclusion, or to digress to the accompanying subthemes, and later, maybe, to once more resume the main story.

So, *Time* magazine presented a practical example, if in a contradictory and linear print form, of an electronically layered hypertext. That is, instead of the subthemes being hidden from view in electronic layers distant from the main text, the page layout of these articles provided a hypertextual, visual example on the one plane. In this way, this journalistic model created a conceptual analogy of hypertext for students yet to undertake projects in multimedia presentation.

The writing task undertaken by the students involved transforming into a layered text the article written by van Gelder, entitled *The Strange Case of the Electronic Lover*, which is reproduced in Dunlop & Kling (1991). Briefly, the story involves deception on the Internet. A male, New York, psychiatrist masquerades as a disabled female, Joan, and develops online, electronic relationships with a host of unsuspecting women. The motives of Alex (not his real name) for these several months of deception are uncertain. Whether Alex saw himself as an earlier *Tootsie* or *Mrs Doubtfire* and could argue some valid professional reason for his actions, or whether he sought only personal gain, remains a mystery. Certainly, Alex (in a complicated sub-plot) developed a sexual relationship with one of his new female, 'on-line' friends, and eventually was unmasked. An interesting outcome was the reaction of Alex's 'victims'. Most did not condemn him, but spoke only of the pleasure and benefit of their electronic interaction with Joan (Alex's female persona).

First the students analysed the story of the electronic lover, and its many facets became visible as layers, or stories within stories. As they set about planning the four pages allowed for their review essay, there was much to interest both male and female students, and their responses to Alex's deception were varied. Some were offended by the deception, while others were more tolerant, and these divergent opinions, interestingly, were represented not only in words but in the scanned photographs which they chose to represent Alex.

Some students created an ethical debate as the framework for their review, some highlighted gender issues, while others extended their review to the wider concerns of behaviour in global communication networks. Others, still, followed the journalistic view that here was an interesting story whose nuances could best be highlighted by the interplay of banner headlines, subheads and pullquotes with the text, and with typography and graphics chosen for visual impact, in page layout software which allowed these differing story lines to be given individal emphasis in ways not available in the linear, wordprocessed, original version of van Gelder's article.

So, page layout software allowed the composition of diverse pages, each exploiting text and graphics to construct 'commentaries' on the main story. Importantly, the students created their own fragmented, but connected, textual format, which was a hypertext, but in a single plane.

There was a significant increase in student understanding of the meanings and issues contained in the story as they wrote with software which allowed the visual representation of its various facets, and the structural planning of their review essay. Before writing electronically, the students created pencilled drafts of the layout of each of their four pages, much as an architect would make preliminary sketches of individual living or working spaces before proceeding to the formal plans of a building. Of importance here was the visual advantage of seeing discrete but connected pages of text, a view which is denied to the writer when working in the linear, medium of wordprocessing. Of great significance was the students' planning, not for the purpose of page layout only, but as an integral part of their story-telling, an element so frequently missing from the work of student writers who work with word processors.

After completing their desktop publication, the students were asked to describe how the story might have been enhanced further in a multimedia format, for example, with the use of audio/visual interviews with Alex's so called 'victims', or with ethical debates, or street interviews which would act as straw polls of citizen opinion. There was an imaginative response from these students which demonstrated not only their acknowledgement of the potential of writing in a multimedia format, but also their conceptual understanding of how this could be accomplished.

5. Conclusion

Hypertext and multimedia systems present advantages and disadvantages for readers and writers. Theoretical arguments insist that hypertext is a system which offers an absence of direction, where textual meaning can be suspended on an immediate level, thus allowing its readers to compile their own experience of the text as a whole. Such is the case with the fragmented but connected texts of the newsmagazine writing genre which allow discontinuous reading without loss of meaning. However, the problem for writers who use hypertext is the need for a conceptual, navigational map so that information might be juxtaposed without loss of meaning in an environment of transparent windows, paths and links, and one which lacks the traditional structures of chapters and closure.

The students in this study demonstrated the usefulness of page layout software in providing a pathway to the conceptual understanding of writing with multimedia, as well as their enthusiasm for writing in this format. Reluctant writers seemed better able to cope with writing smaller, but related pieces of text, and enjoyed communicating with graphics as well as text.

The outcomes of the study suggest the beneficial effect of a familiar analogy in building conceptual understanding in computing novices who are about to undertake further study and projects in the non-linear environments of hypertext and multimedia. Also suggested by this research is the potential of multimedia for writers and readers to interact more fully with the layers of information in a textual piece. Certainly, in this study there was a significant increase in student understanding of the meanings and issues contained in the story as they used software which allowed the visual representation of these layers of meaning. As well, the planning and revision processes in student academic writing were encouraged by the rough sketches made by the students, which acted as conceptual maps as well as the structural underpinning of their writing.

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Clinical Decision Making in Nursing Practice with Case-Based Reasoning

Associate Professor Som Naidu, PhD
Multimedia Education Unit, The University of Melbourne, Australia
e-mail: s.naidu@meu.unimelb.edu.au

Ms Mary Oliver, RN, M.Ed.
Department of Nursing, The University of Southern Queensland, Toowoomba, Australia

Andy Koronios, PhD
Department of Information Science, The University of Southern Queensland, Toowoomba, Australia

Abstract: This paper describes the development of a self-paced multimedia learning resource designed to facilitate the transition of graduating nurses into the workplace. The resource uses an authentic case to simulate the complexities of life in a typical hospital ward, and place graduating nurses in the role of problem-solvers. Problem solving in the simulation is based on a rich repertoire of cases and stories that have been extracted from the experiences of expert practitioners. This case-based reasoning architecture reflects a model of learning where graduating nurses are coached in the development of decision-making skills within the context of a contrived but an authentic presenting problem. Outcomes of formative evaluation carried out in a semi-structured format with individuals and small groups of nurse practitioners have revealed a positive disposition towards the resource and the approach to learning it utilises.

Educational Problem

Current practices in the preparation of nursing students for a successful transition into the workplace is reported as being ineffective. Meanwhile, the Graduate Nursing and Preceptor Programs offered by the hospitals (at least in the Australian context) to facilitate the transition of graduate nurses into the workplace are under tremendous strain. It has been suggested that in order to prepare better nursing graduates for the challenges of the workplace, there must be alternative ways of developing the decision making skills of graduating nurses *in situ*. This implies improved collaboration between the employing organizations and Nursing education institutions to develop additional strategies to formal classroom and clinical education processes that could be used by the graduating nurses in their workplace in a self-paced and self-instructional environment. Moreover, this alternative solution to the continuing concern for the successful transition of graduating nurses into the workplace had to be solidly grounded in the authentic problems and situations of their daily routines. The learning tasks had to be immediately relevant and meaningful to them, not contrived or removed from their workplace environment. The learning architecture used would be powerful if it benefited from the experiential knowledge base of practitioners.

Instructional Solution

In attempting to address this need, we developed a self-paced and self-instructional multimedia learning environment using the case based reasoning architecture. The material presented on this learning environment attempts to simulate the complexities of life in a typical hospital ward, and in so doing making the education of graduate nurses and students case-based and authentic.

Learning activities incorporated in the courseware require users to make decisions about the best course of action, and source of information regarding each case or problem. Users are also able to discuss the cases presented to them in the multimedia environment and reflect on how they might have addressed the situation. This learning architecture reflects a situated cognitive model of learning where students and graduating nurses are coached in the development of their strategies for recognizing learning opportunities and critical thinking with the help of authentic cases.

We have not recommended throwing out all the other resources and abandoning students in a welter of diverse information sources presented in this multimedia environment. On the contrary, we suggest leading students very carefully through unstructured problem situations from multiple perspectives and sources of information, providing careful instructional feedback, not only on content mastery but also on the skills of information-processing, critical thinking, and clinical decision-making.

Implications for Advances in Learning

This project proceeded from the realisation that current practices in the preparation of nursing students' successful transition to the workplace upon graduation are ineffective and deficient. Moreover, it was of the view that more of the same kind of education was not going to be very useful and argued for a radical shift in the approach to this component of nursing education. A shift which would combine powerful educational technologies and proven learning strategies to build a technology enhanced learning environment. This environment is innovative in two ways. First, it integrates powerful technology with case based reasoning in an integrated learning environment. This adds to the currently burgeoning enthusiasm in the use of interactive multimedia applications for enhancing learning and teaching effectiveness. Secondly, it comprises a significant shift away from current practices of teaching and learning towards one that is case-based. In this environment student assessment is situation-specific and as such authentic.

Theoretical Foundations

There is considerable support for the belief that learning and teaching is most efficient and effective when it is situated in realistic settings where learners are clear, not only about the reasons for learning but the context or the ecology of their learning environment. This view of learning is in contrast with the notion that subject matter content is something that can be represented in schemas stored in memory and retrieved in certain ways when needed. The foundations of these beliefs are derived from cognitive science and artificial intelligence, and trace back to Gestalt Psychology and the works of Wertheimer, Kohler, and Koffka, who were German Psychologists of the early 20th Century (Bower and Hilgard, 1981). Gestalt psychologists argued in favour of the role of *insight*, *perception* and *reflection* in the learning process as opposed to *association* based primarily on past experience, such as that proposed by Thorndike, Skinner and Pavlov (Bower and Hilgard, 1981). This philosophy of learning and teaching translates into the premise that to educate and facilitate learning we must create situations that are not only motivating and challenging, but that necessitate learning of facts, principles and procedures. One tried and tested way of doing this is through a Goal-Based Scenario (GBS).

A GBS is essentially a contrived situation in which learners assume a main role. Their "goal" as part of this role is to accomplish the mission or task associated with that main role in the scenario. In order to achieve this goal the learner will need to acquire particular skills and knowledge. *This is where the learning is taking place.* Goals in this context refer to the successful completion of the task at hand not the achievement of grades. A GBS serves to both, motivate learners and also give them the opportunity to "learn by doing". As long as a goal is of inherent interest to learners, and the skills needed to accomplish those goals are the targeted learning outcomes, we have a match and a workable GBS. The important idea here is that a GBS is organized around "performance" skills and the end result is a student who can perform the specified task.

Every aspect of human behaviour involves the pursuit of goals. Sometimes these goals are simple, like brushing your teeth to prevent decay; sometimes they are quite subconscious, like searching for similar experiences when you encounter a new experience. Sometimes they are quite complex, like trying to build high quality software to effect change in the education system. When goals are simple, we really don't think about them much. When they are subconscious we don't think about them at all. And, when they are complex, we may think about them, but find the going so rough that we hone in on the simplest ones and lose the forest for the trees.

But understanding how people pursue goals is a critical aspect of understanding cognition. For computers to really understand human stories, they need a complete model of the goals that people pursue, the plans, the use, and the complexities that arise. The issue is this. If goals underlie human behaviour to the extent that we cannot understand a story or what someone says or what someone wants, without a clear assessment of the underlying goals and the interaction of those goals, then it follows that goals are at the root of human learning. Why would anyone learn anything if not to help in the pursuit of a goal? Why would anyone try to understand anything if not because they had the goal of learning new information from what they were trying to understand? The desire to change one's knowledge base, to comprehend what is going on about you, and to learn from experience, are all pretty much different ways of saying the same thing. And, all of these are goal-directed. If goals are at the base of the human thought process, then it follows that learning must be a goal-dominated arena as well.

The intent of a Goal Based Scenario is to provide motivation, a sense of accomplishment, a support system, and a focus on skills rather than facts. Facts can be deceptive. They give the sense of knowing without the significance of knowing. Understanding why you are doing something, having a clear goal that is more than the recitation of facts, truly knowing why and wanting to know more so that one can become curious about more "whys" is what learning is all about. Goal Based Scenarios, interrupted by good telling of important cases, offer a reasonable framework for courses that are meant to be the means of education.

Learning Architecture

Perhaps the most harmful misconception people have about intelligence is that being smart comes from knowing a lot of rules. Behind this notion is the sense that reading a lot of textbooks and absorbing what they say will lead one to become an expert. While it does make sense to say that intelligence comes from knowledge, most of that knowledge in practice looks quite a bit different than what you find in a textbook. The architecture of this learning environment follows from the premise that if we are to prepare better graduate nurses for the challenges of the contemporary workplace, we must shift our focus from a content-centred to a case-based reasoning approach. The case-based reasoning approach is based on the principles of a situated cognitive model of learning (Schank, 1997, 1990; Schank and Cleary, 1995). The primary propositions of the situated cognitive model of learning are outlined by Savery and Duffy (1995) as follows:

- understanding is gained through our interactions with authentic cases and *in situ*;
- cognitive conflict is the stimulus for learning, and also determines the organization and nature of what is learned.

In this multimedia learning environment case-based reasoning is used to improve current instructional practices in the education of nurses for their transition into the workplace (see Figure 1). The intent of this model is to present students with a contrived but an authentic scenario, which offers them an opportunity to learn in a safe environment, and by making mistakes without injury to real human patients. We argue that mistakes offer real opportunities for learning when these are accompanied by timely and potent feedback. We will now describe this model in some detail.

Clinical Decision Making with Case-Based Reasoning

• Learners encounter the problem situation as they enter the learning environment. • They deal with the problem (in a safe environment) with help from experts in the form of their experiences and stories, and also documentation and other resources available in electronic form. • Their "goal" in this simulation is to develop an action plan for managing the patient's situation. • This action plan is considered at the "case conferences" where feedback is provided.		
Phase I: Case Encounter		
• Learners encounter the case at *handover* where they are explained its history and pathology.		
Phase II: Understanding Problem		
Precipitating event	**Identifying its causes**	**Managing the situation**
Learner encounters the precipitating event.	Learner seeks to locate the cause of precipitating event.	Learner attempts to manage the situation.
Phase II: Seeking Solutions		
Becoming aware	**Asking questions**	**Reasoning**
Learners listen to the stories and experiences of expert practitioners.	They ask experts questions about their work experiences.	Learners attempt to reason on the basis of the stories of experts.
Phase III: At the Case Conferences		
Raising issues	**Asking questions**	**Reasoning**
Learners explore new and related issues to the problem by reviewing sources of information.	They ask experts additional questions about their work experiences.	Learners develop their final action plan based on the stories of expert practitioners.
Phase IV: Developing an Action Plan		
• Learners submit their action plans to supervisors and receive feedback on their decision making.		

Figure 1: Clinical decision in nursing practice with case-based reasoning. The phases in the figure guide the procedure for attempting to use the repository of cases.

Case Encounter

As users enter this learning environment they are presented with a clinical case in the form of a scenario. A guide (which is always available) welcomes users and informs them of their immediate goal. In this scenario learners are required to make clinical decisions on the basis of information that is available to them. This information is presented in the form of documentation and expert knowledge (which are encapsulated as stories) to manage a crisis situation. Users begin by attending a *handover*, which is a regular event of a nurse's daily routine where relieving nurses are updated on the current situation of their patients and this is where the user encounters the case. As in a real hospital setting after *handover* the learners move on to attend to routine nursing care activities and meeting patients' needs by administering medications and ensuring patients' comfort. Soon after this users are met with a "precipitating event".

A precipitating event in this instance is an emergency situation that causes, or has the potential to cause a chain of events. It requires the learner to make complex decisions under the pressure of time. Within this learning environment though, time is not a variable because this is a contrived learning situation in which users have the opportunity to review relevant documentation and seek advice from experts if necessary, on the best practice before making decisions. This becomes the "goal" or mission of users, which is not to be confused with a "learning outcome". A learning outcome is a skill that learners will develop (such as decision making) as they seek to fulfil their goal or mission. In order to achieve this goal or mission, the first thing the learner must do is to understand the situation and control it because the situation has the potential to deteriorate, and then develop an appropriate action plan to manage the situation.

Managing the Situation

In the first instance, the learner must do everything that is necessary to manage the crisis situation before recommending an action plan. In order to do this, it is necessary that the learner *understand* the crisis, including its causes.

In this scenario the learner is presented with a situation in which Mr. George Parker (the patient) is experiencing an anaphylactic reaction to a drug administered and to which he has been previously sensitised. To diagnose this situation accurately, the learner needs to assess the patient's condition. In order to arrive at a correct diagnosis, learners can access a whole range of information including documentation on hospital procedures/protocols and video-clips of interviews with expert practitioners (experienced nurses) on appropriate procedures to follow or not to follow under such circumstances.

After diagnosis the learner must take appropriate action to manage the crisis situation by generating an action plan. But before the learner develops an action plan, they are prompted by the learning system during each step of the transaction to identify and sequence (from lists) appropriate actions that are necessary for correct diagnosis and management of the anaphylactic reaction.

For example, during diagnosis the system asks the learner, *"What would you be looking for to confirm that George Parker is at risk of an anaphylactic reaction?"* It allows the learner to choose from a list of past events or patient characteristics the appropriate triggers that would confirm that this patient is indeed at risk of an anaphylactic reaction that is about to take place. This action plan requires the learner to make decisions about prioritising and delivering care that is appropriate, given the circumstances.

Users are able to make these decisions after having listened to the experiences of expert practitioners. These experiences (reported as vignettes) are presented in the form of stories and made available to users as they make their decisions. *This is where the learning is taking place for the learner.*

In real life, nurses do not have the time in a crisis situation to consult anything because of the pressure of time associated with the situation. In this context however, they are allowed the opportunity to stop and reflect upon each possible action they can take, and seek advice and information, review the underlying pathology of the case, and policies and protocols governing such situations before including them as part of their action plan.

Reflecting at Case Conference I

When an action plan has been developed, users proceed to a case conference. This is a place where users have the opportunity to reflect upon their own action plans and that of others. There is the opportunity here to engage in collaborative negotiation of meanings, questioning, critique, and commenting on alternative approaches of care that is deemed appropriate to the case. There is the opportunity here for invoking cognitive conflict in the learner, which has the potential to lead to changing perceptions that result in learning.

Reflecting at Case Conference II

The second case conference offers an opportunity for learners to obtain feedback on their revised action plans. This has the potential to lead to further cognitive conflict for learners and lead to further questions and critique that can result in learning.

Developing an Action Plan

In the final stages, users ought to be in a position to develop an action plan that is based on informed decision making and one that is realistic and acceptable to their supervisors. By now it will be clear to users that the process of reaching this stage is more important than having the action plan accepted. The architecture of the model was designed to develop in learners clinical decision making skills. And it sought to achieve that by focusing and urging users to learn from the experiences of expert practitioners. Its expressed intent was to expose nurses to the process of clinical decision making and encourage them to make decisions on this basis so that this process is automated for them. Ultimately, within this case-based reasoning environment and through the use of critical thinking users should hone their problem solving skills and ability, in making appropriate clinical judgments concerning patient status.

Development

The development of this interactive multimedia courseware product adopted a *user-oriented* approach (Goodyear, 1995) which comprises ongoing testing and formative evaluation of the prototype by experts in multimedia courseware development, content experts and a selected sample of intended users. This multimedia environment is being developed using Asymetrix's Multimedia Toolbook™, a quasi-object-oriented, event-driven development system for Microsoft Windows™. Toolbook™ combines database functionality, text manipulation, hypertext, drawing capabilities as well as a full-featured programming language called OpenScript™ which allows the developer to program object behaviour. Toolbook™ offers all the advantages of a prototyping tool and is best suited in projects where user initiated changes need to be made during the development process.

This prototype is currently undergoing a series of iterations of progressive development. The highly modular nature of object-oriented programming allows the developer to test each object and its behavioural characteristics. This learning system contains both generic content about the diagnosis and management of anaphylaxis as well as specific procedures and protocols that are specific to St Vincent's Hospital in Toowoomba, Queensland, Australia, which has served as the reference site. Furthermore, in order to achieve the most realistic nursing clinical decision making environment possible, all participants in the video clips used in this multimedia courseware are nursing practitioners who have volunteered their time.

Procedure

Much of human reasoning is case-based rather than rule-based. When people solve problems, they are frequently reminded of previous problems they have faced in similar situations. Most people have experienced problems brought about in their daily life. For instance, you are in a queue at the ATM to withdraw money and you realise that you forgot your PIN number, you are reminded of other times you have been in similar situations. While rushing to catch a train you realise that you do not have the right change to purchase a pass from the ticket machine, you are reminded of other times when you have been similarly caught out. People constantly experience such "remindings", comparing one experience to another so as to learn from both.

Often we believe that our mind is wandering, as it seems to flit from thought to thought, leading us in directions that often seem irrelevant to our needs at the time. But the reminding process is reflective of our mind's constant search for past information to help in processing new information. In effect we are creating theories about the minute details in the world around us, trying to create a theory of banking procedures that will help us to select the right one and better function in the world. We are constantly accumulating cases and comparing those to the cases we have accumulated in an effort to understand the next case that will appear.

In line with this process, the first step in the development procedure for this project was to develop and shoot the precipitating event. The experiencing of anaphylaxis was chosen as the event because it represents a reasonably complex occurrence in a hospital as well as a common scenario in the community, for example, children receiving immunisation at the clinic, or being stung by a bug etc. Except for the patient experiencing anaphylaxis, all other participants in this video shoot were educators and health professionals. The next major task was to capture a large enough repository of the experience of nurse practitioners in the form of stories. Gathering this repository was no mean task. Interviewing, filming, and editing of these stories took up much time. Indexing of the database of these stories was an ongoing exercise.

The model of learning outlined in Figure 1 guided the development of the learning transaction. This unfolded in several phases. Within the multimedia simulation, users could move easily from activity to activity towards their ultimate goal, which was the successful management of the presenting problem. Some of these activities comprised selecting from a number of decision options, dragging and dropping them in appropriate boxes, deciding to administer a particular treatment or not, deciding to call for help or not, choosing to consult expert video clips for advisement or not, and making decisions. Resources apart from expert's stories such as procedures and other reference manuals had to be identified and collected for the reference of users.

Evaluation

Our approach to the monitoring and evaluation of the outcomes of this project was utilisation focussed. As such our focus was on the use and utility of the instructional innovation for nursing students, their lecturers, graduate nurses, and other stakeholders such as the employing institutions. Evaluation of the courseware prototype is continuing. Formative evaluation of courseware has been carried out with small groups of potential users including a small group (n=3) of subject matter experts who were asked to validate, among other things, the authenticity of anaphylaxis. A semi-structured Expert Group Checklist has been used for gathering the comments of the expert group. A semi-structured questionnaire including an Interface Rating Scale has been used to collect data from the group of potential users. A larger scale implementation evaluation of this courseware is planned. This will involve observations, focus groups and use of semi-structured questionnaires.

Results of the formative evaluation carried out so far show that:

- users found the learning program easy to use and navigate,
- the majority did not find the information overwhelming, and the content pitched at a appropriate level for the target group,
- the curriculum was well balanced.

With regards to interface design:

- users felt that the screen design was pleasing and appropriate use of graphics was made,
- the clarity of information presentation was high.

On the whole they found the program enjoyable. Subjects were asked how *interesting* did they find the material on each one of the sections on the CD? Material on the CD was itemised to include: Handover, attending to patient, listening to stories, making decisions, and preparing the report.

- The majority reported each one of these sections either interesting or very interesting.

Subjects were also asked to rate the *usefulness* to them of these same attributes.

- All of them rated these attributes either useful or very useful.

In summary, what did they like most about the multimedia-based simulation? These included simple access to different components, more interesting and retained information in comparison with reading a journal article or book, realistic presentation, interactive patient observation.

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Object-oriented Instructional Design and Applications to the Web

Robby Robson, Department of Mathematics, Oregon State University, USA. Email: robby@orst.edu.

Abstract. In 1945 Vannevar Bush created a theoretical machine that constructs and stores knowledge as trails through information. This presages Web-based learning and points out that authoring and delivery environments should be based on information and knowledge constructs. Unfortunately, current Web-based learning environments are based on the manipulation of data. This approach links data rather than ideas, forces authors to think about form rather than pedagogic substance, and makes it almost impossible to extend the functionality of commercially available learning environments in new and creative ways.

An information-based approach can be realized using the object-oriented paradigm applied first to instructional design and then to the software built to support it. This note summarizes our work in this direction. We treat the problem of hyperlinks with conclusions similar to those of Hermann Maurer's Hyperwave group and illustrate how the object-oriented approach can add extensibility to on-line learning environments.

Hyperlinks, Data, and Information

When thinking about pedagogy it is useful to distinguish among *data, information,* and *knowledge.* In (Robson 1999) we illustrate these epistemological categories by looking at tabular data that is to be included in a document or lecture. The main point is that forcing an author to enter data into table cells via a GUI fixes the form in which the data is displayed. This makes it impossible to specify context sensitive rendering methods and thereby inhibits the ability of an author to think in terms of connections among ideas. Instead, the author is forced to spend time on the format used to display data. A table or graph is a means to convert data into information and the problem we encounter is that the authoring system confuses the two.

Another fundamental example of this same phenomenon is the notion of a hyperlink itself. It has been pointed out by that standard hyperlinks carry with them the same flaws that GO TO statements carry in programming languages. To quote from (Lennon & Maurer 1996),

> There is certainly no significant data model for WWW, and in many ways first generation systems may rightly be likened to novice programs that used too many GO TO statements.

Manifestations of these flaws are the prevalence of broken links, the inability of users to annotate documents, and the difficulty of creating symbolic links by traditional means. The computer science analysis of the hyperlink problem is that hyperlinks should be object-oriented instead of procedural in nature. This approach is taken by Kappe, Maurer, and Tomek in their work on the Hyperwave system developed at the Institute for Information processing and Computer supported new Media in Graz, Austria (Maurer 1999).

Whereas we agree with the Hyperwave solution, from the pedagogic perspective the underlying problem lies in the confusion of data with information. In the minds of authors, hyperlinks are symbolic and informational. For example, an instructor might wish to insert a link to a brief biography of Linus Pauling into a Web page discussing Vitamin C. The instructor may or may not have a specific biography in mind. The URL should really be "link that displays a brief biography of Linus Pauling" rather than something like http://bio.linus.pauling.edu. By hard-coding the URL of a link, information is replaced by its instantiation and becomes data. This is not what we want.

Vannevar Bush's memex machine (Bush 1945) is considered to be a visionary description of the Web (Berners-Lee, 1995). It is actually an even more visionary description of an on-line learning environment. Below is a quote from the memex article that describes the use of the machine. Note how the owner's goal is described using the words "interest" and "study", which implies a quest for knowledge, and that this knowledge is constructed by finding information (books and articles) and linking this information.

> The owner of the memex, let us say, is interested in the origin and properties of the bow and arrow. Specifically he is studying why the short Turkish bow was apparently superior to the English long bow in skirmishes of the Crusades. He has dozens of possibly pertinent books and articles in his memex. First he runs through an encyclopedia, finds an interesting but sketchy article, leaves it projected. Next, in a history, he finds another pertinent item, and ties the two together. Thus he goes, building a trail of many items. Occasionally he inserts a comment of his own, either linking it into the main trail or joining it by a side trail to a particular item. When it becomes evident that the elastic properties of available materials had a great deal to do with the bow, he branches off on a side trail which takes him through textbooks on elasticity and tables of physical constants. He inserts a page of longhand analysis of his own. Thus he builds a trail of his interest through the maze of materials available to him.

We observe in (Robson 1999) that learning is the process of acquiring or constructing knowledge and that many components of teaching deal primarily with information. As in the Vannevar Bush description, a key component is the forming of cognitive relationships among pieces of information. Yet the vast majority of current on-line educational resources, the current versions of memex, operate strictly in the data domain. In memex terms they are fixated with the physical production of the books and the fonts used for annotations.

This has many negative consequences. One is that too much effort is spent on form and format and too little on pedagogic substance. This contributes to the large cost of developing Web courses or course components at Universities (Arenson 1998 and Harapnuik et.al. 1998). Another consequence is that authors and designers cannot interact with learning environments in a language built around concepts of teaching and learning. This is typified by the need to make hard links instead of symbolic cognitive links. *But the worst effect is that teachers and authors are using technology that dictates and limits on-line pedagogic methods instead of using technology which both serves existing pedagogy and encourages the development of new instructional strategies*. We will discuss that now.

The Limits of Commercial Environments.

Confusing data with information can make more work for the author, but the real problem with the functional nature of current authoring environments is the lack of extensibility. Towards the end of Bush's memex article (Bush, 1945) he speculates that

> Wholly new forms of encyclopedias will appear, ready made with a mesh of associative trails running through them, ready to be dropped into the memex and there amplified.

The Web reflects this in its ability to integrate new sites, but the tools that exploit the Web for pedagogic purposes are limited to the functionality that the creators envisioned. To illustrate this, suppose that we are using a commercial course management system that offers all of the standard amenities: user types, quizzes, navigation, record-keeping, chat, email, and so on. Suppose further that we would like to use this on-line environment to do some new things, for example to

(A) display student progress towards a learning objective as a bar chart,
(B) pair students and have them exchange papers and critique each others papers, or
(C) have different students see different examples on the same Web page depending on their scores on a particular quiz.

These are all things we have done using the Web and that represent sound pedagogy. (A) was suggested to the author by a high school guidance counselor and was implemented in a mathematics Web site. The implementation uses nothing more complicated than an image tag with the width parameter read in from a database. (B) is something we have done using QuestWriter software developed at the author's home institution (Bogley et. al. 1996). In our implementation, the computer takes care of *all* of the management including pairing off students, delivering electronic versions of papers and comments, and sending email reminders when a student falls behind on an assignment. (C) is an example of *adaptive pages*. Adaptive pages have been implemented in a number of academically developed environments including Interbook (Interbook 1996) and QuestWriter (QuestWriter, 1998).

Despite all of this, the creators commercial environments have not included any of the functionality represented by (A), (B), or (C). It might be possible to bend the environments to implement the associated pedagogical ideas, but it would be very hard to do so neatly and impossible to truly add new functionality.

An Object-oriented Model

If our goal is to create an environment that operates on a higher level than data manipulation and that permits users or designers to add new functionality, then we need a new underlying model. In (Robson, 1999) we propose such a model. We start with an object-oriented approach to instructional design that is independent of the medium in which it is realized but works very well for the Web. At its core is the notion of a *learning object*. Examples of learning objects include "explanations", "assessments", "lectures", and "applets". Anything that an instructor or student might use as a path to learning is a candidate for a learning object. In our model the designer (or author) defines learning objects and manipulates their methods and properties. Methods might include ways of rendering an object in various media, and properties might include other objects. An important property of an object is a *relationship* to another object, often rendered as a hyperlink in the Web context. This allows us to incorporate the symbolic and cognitive notions of links discussed earlier in this note.

In (Robson, 1998) we illustrate how this object-oriented model can be implemented in a primitive way. We discuss a few Web sites with ad-hoc authoring environments built using a simple database and Web integration software (Robson & Whitesitt 1999). In these environments the author can associate an external link to the content of a page, or a learning objective to a lecture, by using a pull-down list of available links. Although this is just a first step, it brings out the underlying philosophy that the role of the author is to specify relationships among objects and not to worry about how those relations will be rendered.

Extensibility

Our primitive attempts do not illustrate the possibility of creating an *extensible* environment. We believe this is not only possible but is where the next generation of instructional management systems must go. Although we have built none of this, and therefore must admit the possibility of many hidden difficulties, it is worthwhile speculating about the shape and form of such an environment. What we envision is an environment in which every component can be accessed with full authoring and design privileges by an appropriately authenticated user. The various learning objects would be displayed graphically. Properties could be assigned from lists and sub-objects could be defined with automatic inheritance of properties.

To illustrate what could be done with this environment, start with your favorite course management system and imagine that all components are object-oriented. As an exercise, suppose we wanted to construct a new component that supports group work. We would need a way to form groups, a way to facilitate group communication, a way to give out projects, and a way to determine scores on the projects. Of these, the part that is most obviously missing is the one that forms groups of students, but we could start with the "class" object[1]. A "group" is just a "class" within a "class". We should therefore be able to suitably define a new "group" object that would inherit properties from the "class" object. This would immediately give a

[1] Most academically-oriented management systems include a notion of a "class" (a class of students, not a class in the programming sense) as a top-level construct.

"communication" property that could be realized as a chat room and/or threaded email, an "assessment" property that would allow us to give and score assignments with deadlines, and so on. The assignments associated to our new "group" object should probably be re-named "projects". We would also want to change some of the rendering properties to give the group project a distinctive look and we might want to associate text or interactive exercises to "projects". All of this could be done without much difficulty because our envisioned object-oriented authoring tool supports precisely these types of transactions.

In our own real life implementation of a limited group learning environment we relegate all management tasks to the computer. It would not be so easy to program our environment to automatically create student groups and send email reminders to non-participating members unless similar functionality was already present in our base learning environment. This points out the need for a true programming environment within an authoring environment. High-powered industrial products, for example Macromedia products, have this feature, but academically-oriented management systems generally do not. This is an issue for another time and place.

Conclusion

We have traced a path that starts with the realization that current on-line learning environments are grounded in the manipulation of data as opposed to the communication of information and construction of knowledge. As has been pointed out by the computer science community, even the hyperlink suffers from this defect. Our path takes us through some of the difficulties this causes and proposes an object-oriented approach that allows us to overcome these difficulties. The environment we propose is built around learning objects and, unlike any of which we currently know, has the potential to be extensible. Authors and designers can use it to create new on-line learning objects from old ones. Despite the fact that this journey goes back at least as far as Vannevar Bush, we feel we are just at the beginning.

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Interactivity and Narrative: Strategies For Effective Learning

Roderick Sims
School of Multimedia and Information Technology
Southern Cross University, Coffs Harbour NSW 2457 Australia
rsims@scu.edu.au

Abstract: This paper investigates methods to maximise the benefits of interactivity in the context of computer-based learning applications. To achieve this, the analysis initially reviews the factors which to date have defined interactivity and some recent assessments of its impact, with a subsequent assessment of interactivity in terms of three alternative components - narrative, play and agents. Commentary on perceived problems with interactivity are also discussed. Based on this analysis, the major finding is that mutual reciprocity, a critical element of interactivity, is not manifested in applications and that the introduction of elements of narrative and play have the potential to alter the dynamic of the interactive process. Of greater impact too is the potential to integrate the interplay between designer and learner into the interactive engagement. By integrating these elements, a revised model of the interactive environment is proposed, based on mutual adaptation by designer and learner. By developing our understanding of the complexity of interacting elements which impact the interactive process, we will take another step towards a truly interactive environment.

Reassessing Interactivity

The Interactive World

Interactivity, in the context of computer-based learning, ranges from simple navigation of web-pages to immersion in interactive virtual worlds. It is often portrayed as the distinguishing factor of the new media, with the assumption that "interactivity in a computer product means that the user, not the designer, controls the sequence, the pace, and most importantly, what to look at and what to ignore" (Kristof & Satran, 1995:35). While this holds true for recreational or information-seeking activities, the value of control for educational pursuits is less clear, as there are conflicts between the value of control for new learners as well as questions regarding the overall prescriptions for control identified through research findings (Reeves, 1993).

The overall aim of this discussion is to develop a better understanding of interaction in terms of the factors which inhibit or enhance content engagement, and the communication or transfer which results in deep processing and consequential learning. When considering technology-based learning the significant factor is the engagement which takes place between the learner and the content, and the extent to which there is a change, manifested through learning, skill formation or knowledge acquisition resulting from that engagement.
However, interactivity as a determinant of effective learning has yet to be fully established, based on analysis of a range of sources including theoretical limitations, research credibility and the variety of interactive constructs. For example, Whitby (no date) describes the vision of the future home with a video wall of sports, interactive access to player profiles and holographic video-phones. While acknowledging the popular appeal of this scenario, Whitby (no date:1) questions whether people really wish to interact that way and concludes:

> *... we are rushing to implement interactive CDs, cable shows and personal electronics in the crudest ways without pausing to consider whether an improved medium will result. Storytelling and narrative lie at the heart of all successful communication. Crude, explicit, button pushing interaction breaks the spell of engagement and makes it hard to present complex information that unfolds in careful sequence.*

The problems confronting educational technology developers are clearly defined - how to develop computer-based environments to engage the learner in effective instructional communication without generating *interactive interference*? In addition, Whitby (no date) also introduces the notion that storytelling and narrative are critical determinants of communication, which is the ultimate goal for educational multimedia applications.

Interactive Challenges

In addition to the impact of internet communication in the tertiary environment, the development of stand-alone computer-based learning applications is widespread and often a critical business risk. As we continue to research and develop computer-assisted learning applications, it becomes clear that there remains much to learn about the nature of interactivity and implementing its components effectively and appropriately. In noting that complexity comes with the freedom associated with learner control, Kirsh (1997) asserts that there are additional restrictions resulting from the scripting of applications which require the user to adapt to their structure, suggesting that:

> *Since interactive interfaces ought to foster this type of coordination between improvisation and planning we need to discover better theories of what is involved in the dynamic control of inquiry, line of thought, and action more generally. We need to discover more open-ended models of coherence and narrative structure. (Kirsh, 1997:81)*

While acknowledging that one solution is to scaffold a learning environment to support rather than direct, Kirsh (1997:83) argues that an analysis of the nature of interactivity in terms of reciprocity between the two parties (designer and user) suggests that "computer interfaces are rarely interactive because the programs that drive them are rarely intelligent enough to behave as tacit partners". In this instance, as well as the observation by Whitby (no date), the concept of narrative for coherence is introduced, which Kirsh (1997) beleives might be resolved through the application of a modified decision-cycle theory.

From a different perspective, Bardini (1997) compared the concepts of *association* and *connection* in relation to interaction with hypertext and hypermedia environments, observing that most implementations to date have been associationist, extending the argument to consider the relationship of the main protagonists (agents) in the interactive process. Ascribing the process of delegation and inscription to both the designer and user, "the degree of interactivity of the interface can be seen as the relative opportunity for both user and designer to take part in the two dimensions of the representation process" (Bardini, 1997:12). While this supports the position of Kirsh (1997), it also highlights the potential of creating gulfs (Norman - cited in Booth, 1989) which might compromise mutual engagement of the user and designer - the ideal of the interface as a socially constructed narrative (Bardini, 1997).

In brief, these two observations suggest that interactivity remains an uncertain concept and that developing applications in such a way that the learner is integrated into some form of narrative may lead to implementations which reduce the gulf-potential between user and designer. However, it is also necessary to appreciate that there are many factors that contribute to effectiveness of computer-based learning. The following section reviews these dimensions, with specific emphasis on the relationship between learning theory and subsequent learning.

Learning Theory and Interactivity

To assess the relationship between learning and interactivity in a computer-based environment, it is necessary to examine the extent to which the various approaches to learning provide guidance or indices of relative and appropriate interactions to foster learning. By way of example, Craik & Lockhart (1972) suggest that the conditions of learning can affect whether surface or deep learning results. According to Kearsley (1998), the *levels of processing* approach views stimulus information as being processed at multiple levels simultaneously depending upon its characteristics, and that deeper processing will result in more being remembered. In addition, the meaning of the presentation will affect the extent to which material will be remembered; similarly the less meaning implies greater attention and therefore an interruption to the processing flow.

For the development of a learning task within this paradigm, educators are required to present information both meaningful and relevant, aiming to ensure that attention is focused on the content without interference. Transposed to a computer-based environment, the context within which the material is presented is alien, at least on the first encounter, and therefore attention can be required to de-construct the content from the interface, metaphor or context. If attention is too focused on the de-construction process, it can be argued that the consequential learning might be interrupted or de-emphasised, generating more superficial rather than deep learning. This reinforces the potential of interactivity to actually interfere with the learning process.

From a human-computer interface perspective, Booth (1989) identifies that users can have mapping difficulties when accessing computer systems (matching the information presented with their current experience), which have been described by Norman (cited in Booth, 1989) as being gulfs that prevent users from dealing easily and efficiently with computer-based tasks. The *gulf of execution* exists when the user knows what is to be achieved but does not know which physical variable to adjust or in what way to adjust them and the *gulf of evaluation* exists where the system has altered, usually as a result of the user's actions, but the user cannot easily understand the change in that system's state. The assertion by Craik & Lockhart (1989) that meaning is critical to deep processing underlies the importance of effective design of the human-computer interface if successful engagement is to occur. The interaction of the user in manipulating the system forms a precursor to their interaction with the content and thus any disturbance in the manipulation may have subsequent consequences with that engagement. This example highlights the impact one approach can have on the way we think about interactions and supports further investigation of a wider range of learning theories and paradigms to help clarify the links between interactivity and learning. However, this form of analysis is beyond the scope of the present discussion.

Interactivity and Narrative

Introduction

The overt issues faced by prospective designers, developers and implementors of educational software is often the look and feel of the product. What is often omitted is an analysis of aspects of the total interactive experience that will maximise engagement (manifested through learning, knowledge acquisition or skill development) and the overall communication of content. However, it is proposed that the frequent development in the base technology (mainframe, desk-top, on-line) have taken precedence over developing a comprehensive understanding of the means by which the technology might enhance the learning process.

As continually evolving field, educational technology is often subject to creativity and experimentation as the most legitimate means by which its potential can be realised. At the same time, there is considerable evidence to support the conclusion that we do not yet fully understand its similarity to or differences from current means of educational communication (Plowman, 1996b; Kirsch, 1997). There is no doubt that much of the development has assumed that the technology is simply an automated form of current practice, and this may in part be responsible for the often stated comment that educational technology has failed to live up to its original expectations. In other words, should the implementation of educational resources on a computer-based medium be a replication of current media, or are we dealing with a new environment that has not yet been fully explored in terms of interface to and interaction with its human users?

There is a growing body of literature and discussion which supports the latter position, through a re-assessment of the way in which we conceptualise the use of interactivity in educational multimedia applications. One of the most interesting aspects of this research is the comparison of traditional story-telling techniques (narrative and play) with those presented through the technological medium. While the complex framework which surrounds the study of narrative and story-telling should not be trivialised, in the context of the growing demand for technology-based solutions to learning, the possibilities provide a novel and refreshing perspective.

Interactive Impact

Based on the previous discussion, there is an indication that if interactivity has the potential to distract, the use of narrative may be useful. Narrative can be viewed from a simplistic context of representing a linear storyline (Plowman, 1996a); it can also be perceived in the way it is deconstructed in terms of how the story is told, the way it is received, what meanings it can have and the specific social, cultural and technological context in which it is told (Humphreys, 1997b). An extension of this analysis is the assertion that narrative enables construction of mental models of the situation and environment (Bower & Morrow, 1990). Therefore it can be predicted that narrative may assist meaning, reduce the impact of interactive interference and provide the necessary framework to promote learning amongst diverse groups of learners.

But in what way can narrative, as currently understood, relate (or integrate) with the values of an interactive world? Josephson (1997) suggests that we are still learning to define a new media literacy, and by defining it we are also creating it. If we can define an effective interactive narrative, then we can begin to project what will happen to that narrative as the audience moves from being "actively engaged on an interpretive level to actively intervening in its representation" (Humphreys, 1997a). In a comprehensive analysis of narrative and interactivity, Plowman (1996a:92) observes that

> *Narrative coherence is identified here with a lack of redundancy and a fixed sequence. Interactive multimedia (IMM) programmes challenge these traditional definitions of narrative because it can be suspended or altered at discrete decision points, the foci of interactivity, and a rearrangement of discrete elements gives rise to new text and new meanings. While the concepts of wholeness, unity and coherence of meanings are not fashionable in a post-modern world, in "educational multimedia... the notion of multiple interpretations has different implications, particularly for comprehension and cognition".*

Because these decision points represent the foci of interactivity, and a rearrangement (through branching or learner control) of discrete elements gives rise to new text and new meanings, the implication in educational multimedia of multiple interpretations becomes critical, particularly in relation to comprehension and cognition. While "narrative isn't just a shaping device: it helps us think, remember, communicate, and make sense of ourselves and the world" (Plowman, 1996a:3), when contrasted with its implementation in an interactive environment, its efficacy is uncertain. So can narrative and interactivity co-exist? Plowman (1996b) argues that interactivity is at odds with our expectations of traditional narrative forms and communication. As disruption of the narrative is strongest at the foci of interactivity, interactive multimedia development should be considered in terms of how it can be integrated into the underlying narrative. However, by examining techniques for measuring interactivity and comparing these with the basic narrative structures, the potential for the new media to combine and incorporate effective narrative was examined by Plowman (1996a) who concluded that, with young learners at least, a meaningful narrative was beneficial for learning.

In an alternate view of interactivity, Hilf (1997:7) states that "through the interrupted narrative, the learner learns more about the story and characters through their own interaction". Whereas Plowman (1996a, 1996b) recognised the negative interference potential of interactivity, Hilf (1997) declares the opposite. Clearly there are disparate views on narrative and interactivity, and their combined impact on the communication of content; whether an interactive device contributes to engagement and meaning or generates an interruption to that process is the underlying reason for considering the impact of narrative on the overall process.

In his analysis, Hilf (1997) introduces four narrative structures: linear (where the user is guided from beginning to middle to end), interrupted (where the narrative is halted while problems, tests or some other form of interaction is implemented), branching (where the user has the option to choose from a range of paths) and object-oriented (where elements within the narrative can be controlled or defined by the user, thereby impacting on other users within the system). In terms of interative learning environments, it would appear that branching narrative is termed menu selection and interrupted narrative the tutorial model in which a pre-designed sequence is interspersed with interactivity in the form of the question-response-feedback loop. The object-oriented narrative conforms to the delegation/inscription factors, at least in terms of the user (Bardini, 1997).

From Narrative to Play

So does narrative interfere with or promote engagement during an interactive learning session? The answer is likely to be both, but possibly to the detriment of the final outcome. An extension of the narrative aspects of interactivity are proposed by Humphreys (1997a). Like Plowman (1996b), she suggests that giving the audience (or user) choices can disrupt the sequence of events, affecting the final closure of the narrative. From another perspective, "as the level of interactivity increases and the amount of agency for the user structured into the piece increases, the amount of 'retelling' done decreases" (Humpherys, 1996a:6).

To provide an answer to this, Humpherys (1997b) explored the concept of play and play theory, which she suggests are closely related to narrative, and notes that to maximise audience engagement through interactivity requires consideration of agency, narrative structure, emotional engagement and construction of meaning. The consequences of this conundrum may find some solutions in play theory, which Humpherys (1997b:9) suggests can provide a "framework which accommodates the audience or user into the process of engagement with interactive media in ways that narrative theory finds difficult". While narrative is about the experience of a recounting of a story, play is the experience of enacting a story.

IMAGE NOT AVAILABLE

Figure 1: Intersection and Parallel Concepts of Interactivity

A preliminary comparison between narrative and play interactivity is represented in Fig. 1. The top sample of an interactive sequence represents a narrative regularly intersected or interrupted by an interaction whereas the bottom sample depicts a constant interaction between user and story. While play in terms of the instructional game has long been recognised as a valid model (Alessi & Trollip, 1991), the early implementations were not contextualised in narrative. By integrating play elements such as friendship, risk, problem solving, competition and creativity, Humpherys (1997b:9) suggests that "play theory offers a framework which accommodates the audience or user into the process of engagement with interactive media in ways that narrative theory finds difficult". More importantly, in the context of educational applications using multimedia, Humpherys (1997:11) speculates that "Interactivity produces for the user of media a different relationship to story. This shift in relationship may be able to be framed as a shift from narrative, as an experience of recounting a story, to play, as an experience of enacting a story".

The notion that multimedia applications for learning should focus on either narrative or play to enhance engagement implies that the interactivity provided to users must therefore be integrated in such a way that it not only provides opportunity to reinforce the specific learning objectives but also to maintain the user's participation in the story.

Multilinear Narrative

Rather than comparing the traditional linear narrative with non-linear interactive multimedia, Johnson & Olivia (no date) use the term multi-linear. This term implies a range of equally plausible paths which may be taken through the application and offer the suggestion (with respect to internet sites specifically) that beginnings and endings should be replaced with the terms entrance and exit. In discussing the relationship between the content and the medium, Johnson & Olivia (no date) cite the work of Liestol 1994:105:

> *The screen occupies a third position, between the three dimensions of space and the one dimension of time. The screen and what it presents is a manifestation of the present, between past and future. Therefore the movement from space to time and the reduction from three dimensions to one both halt at the position of the screen and its flatland of two dimensions. Obviously the design and composition of elements on the screen are of central importance to any critical study of hypermedia texts.*

This introduces a further variable to the equation of effective interaction with respect to the user having to develop the skill to either adapt to changing dimensions or to create a new dimension by which they interpret the technology interface.

Conclusion

Interactivity is often portrayed as the crucial element of the new technology, and yet recent research has demonstrated that there is still much to understand about the ways in which the interactive process facilities access to technology, especially in the context of computer-based learning applications. As Plowman (1996a:102-103) states,

> *disruption of the narrative is strongest at the foci of interactivity ... (which) should be considered in terms of how they can be integrated into the overall narrative and how they can be used as a way of stimulating interest in the unfolding narrative ... by considering the interrelationship of narrative, linearity and interactivity and their design implications we can help learners to make sense of interactive multimedia.*

And it is our challenge to develop applications which minimise the potential for interactive interference. By considering the concepts of narrative and play in association with the links between the designer and user, a model of adaptive applications which cater for both designer and user is proposed as a means to enhance the interactive process.

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Architecture in the Digital Domain: A Collaborative Design Studio

Barry Jackson,
School of Architecture
New Jersey Institute of Technology
Newark, New Jersey 07102, USA
bxj2634@tesla.njit.edu

Abstract: This paper describes an interdisciplinary design studio that utilizes concepts and methodologies intended to create a comprehensive approach to the organization of building design through the merger of several techniques. These techniques include 1) collaborative learning and design, 2) using multi-tasking workstations, 3) hypertext learning modules and courseware, and 4) interdisciplinary team teaching. The studio merges the preceding teaching paradigms, building on current research and the experience of the faculty. The studio also establishes the premise that architectural design studio and engineering laboratories (structural and mechanical) will need to be organized across departmental boundaries as team oriented activities. Learning modules are being developed in a multimedia format, using analog video and hypertext. The modules are expected to be completed using digital video, allowing latitude for evolution of the material. The paper discusses the continual shift between synthetic and analytic processes in the context of problem solving. Also discussed are methods of representation, design assignments and design methods and process.

The Problem

Architects and engineers, who need to interact during their professional career in order to build any kind of complex building, are educated entirely separately. "Over the past century, increased movement toward concentration within an academic discipline has taken charge of the curriculum, as well as serving to compartmentalize the professoriate and the institution." (Landry 94) The vertical separation of disciplines occurs in most universities. This suggests a need for modification of the curriculum and teaching methods, and development of the delivery of course material. Fortunately, this comes during a period of reflection in schools of engineering and architecture when, as Mitgang suggests, there are "growing doubts over whether the traditional educational environment is preparing students for a rapidly changing world outside." While "schools remain wedded to shopworn traditions" there seems to be a growing malaise about the role of design as the centerpiece of architectural education. (Mitgang 97) Recognition of the problem also comes at a time when new teaching methods are emerging.

The problem with the vertical separation between disciplines is that students from each discipline learn to solve their part of the problem independently. This separation discourages them from understanding the relationship among the problem components. The students usually complete their projects without having the opportunity to gain insight to the trade-offs required for an optimal solution. While courses in each department include information about the other disciplines, each is taught in a manner which tends to diminish the importance of integration. Moreover, the ultimate professional relationship among the disciplines, which in the building industry consists of teams, is downplayed by the students working as individuals in their classroom experience. Research outside of the architectural and engineering professions suggest that "future work situations are likely to use a complex mixture of different information channels, including video conferencing, e-mail, small group work, and on-line searches." (Kilker & Gay 94) In other words, information and designing systems are being developed which rely on new modes of interaction, intertwining the sociological and technological aspects of the design process. These are the conceptual underpinnings of the development of a new approach.

Designing the Solution

The major effort in trying to refine elements in the curriculum (particularly in different departments) depends upon what might be termed "changing the culture" of the curriculum. To create these changes an architectural design studio/engineering laboratory, TOTAL STUDIO, is being organized comprehensively, across departmental boundaries. The course is being changed from independently organized activity to a team oriented activity. The hypothesis is that a concurrent and collaborative design environment will add to the problem-recognition and problem-solving abilities of the engineering and architecture students. In most workplaces in the building industry, problems solving and design require collaboration among members of a group. These activities require that people share information and coordinate their activities in a setting that allows for immediate interaction (Kilker & Gay 94). Although the design and production of buildings traditionally requires collaboration, the work is done serially, with drawings passing among the professions and each adding their information and recycling through the process until the project is completed. No methods of optimization are applied because of the way the design process is structured. Optimal solution spaces are closed off by the time each new part of the process is introduced. Therefore, the focus of the studio is around the activities in which the students can engage to help construct a comprehensive knowledge base necessary to design, optimize and build complex structures.

The impact of the studio is to improve the education, professional behavior and attitude of students as they prepare for various aspects of the building industry. The students have the opportunity to see how the separate courses they have taken in architecture, structural engineering, and building performance are integrated. They can observe that contemporary construction is not a simple separate, sequential process, but rather a system characterized by integration and a search for optimal solutions. When design is objectively considered as an iterative, multifaceted process, and a series of problem solving sequences, a significant paradigm shift can occur. Emphasizing this way of thinking, we discovered, is imperative because the way engineering and architecture students learn is different.

Our goal is to create a completely computer mediated environment, where students work on their designs and problems, communicate with each other both locally and at a distance, and receive courseware and criticism at the workstation. One innovative aspect of TOTAL STUDIO is that it is interdisciplinary, and has been designed from the beginning to provide the format for the perpetuation, replication and dissemination of the studio in a continually upgradeable hypertext format. The studio focus has moved away from the traditional piecemeal design methodology.

Implementing the Solution

The Underlying Pedagogy

The study of building design must be rooted in a general theory of building science in which architectural space and form, structure, and the environmental aspects of the building envelope are considered inseparably. Optimization is a complex problem to solve. "In architecture, aesthetics deals with the way buildings look: the skin, form, site, and overall image within the culture to which they belong. In engineering, technology is informed by modern science and is systems and process oriented. Controlling building environments (both actively and passively) can produce more insightful architecture when an understanding of the aesthetics of the building envelope (static) is paired with an appreciation of the technology of the building systems (dynamic)." (Greenwood et al 97) The studio focuses on the development of structural, energy and spatial intuitions and the relationship among them. Study of highly indeterminate structures is crucial for understanding building frame design. (Black and Duff 94) For energy analysis and building performance, it is preferable to analyze a skin-dominated building so that relationship of form to energy flow can be considered. One goal of the faculty is to identify projects at the appropriate scale to study these relationships. We are currently using an elementary school project which seems to have the requisite components and degree of difficulty.

Collaboration and the matrix of studio organization

Collaborative design—thus collaborative learning about a project—is a new concept for students in the studio. A very serious introduction is required to get the students working collaboratively. Collaborative learning is

"...a learning process that emphasizes group or cooperative efforts among faculty and students, active participation and interaction on the part of both students and instructors, and new knowledge that emerges from an active dialog among those who are sharing ideas and information." (Turoff 95) While group criticism and group research is a normal activity in the design studio, designing together is not. Turoff, is his years of development of computer-mediated environments at NJIT concludes that "in many learning situations it has been observed that two people working together at a computer learn more working together than either one separately. It is this ability to share the actual interactive process of 'creating the painting' that this approach entails." (Turoff 95) This suggests, as Feisel points out, that "we need to design an educational process that involves students in one another's learning and rewards mutual accomplishment." (Feisel 94) The studio adapts these concepts and builds on them.

To facilitate the collaborative idea of teaching and learning, the studio is organized around a matrix of groups and teams. Groups are defined as a number of students organized to develop techniques and learn a particular set of the task. Teams are defined as a number of students assembled to apply techniques and complete a design task. Each student is a member of one group and one team. The sets of teams and groups act as support clusters for each student. In recent semesters, the four by four matrix of teams and groups has been applied. The teams and groups for the first part of the semester are four member each. When the major design project begins the teams of four are divided into teams of two. This affords the opportunity to modify teams to improve interpersonal relationships among the members. The team organization depends heavily on the mix of students. The current mix is two architecture students working with one engineering students. Each semester slight variations on the model have to be developed to accommodate enrollment.

The Learning Groups

In theory, the learning groups should be divided among the three disciplines involved in the project: architectural design, structural design, and mechanical design. Each learning group will be led by an instructor who will develop the educational modules associated with that discipline. The members of each learning group will be responsible for learning the software packages associated with specific segments of the problem and also be encouraged to share their knowledge. As the experiment evolves, different uses of learning groups are developed. For example, last semester project research assignments were made by the learning groups; this semester software instruction is carried on in learning groups.

The Design Teams

The design teams develop the building design as a whole. During their sessions with the design instructor they work together on the development of the project, each member looking at, and engaging, the design from the perspective of their learning group and/or discipline. Architecture students and engineering students work together on the design, each naturally contributing from the point of view of their background. While it is intended that contributions to the design are made across disciplines, there has been a tendency for the engineering students to wait for the architecture students to finalize their designs before contributing their engineering expertise. Changing this attitude toward design is central to the success of the project. This year we have separated the engineering students by semester (structural engineering in the fall; mechanical engineering in the spring.)

The Simulation, Animation and Modeling Laboratory (SAML)

The studio is held in an advanced graphics computer laboratory with video equipment available for various levels of production. The laboratory has been developed with support from NJIT and the National Science Foundation (NSF) (Jackson, 97a, 97b). The computers are networked with adjacent computer laboratories and the Internet. The laboratory is also adjacent to the Multimedia Internet Delivery and Production Studio (MIDPS) which is part of the New Jersey Center for Multimedia Research (NJCMR). This provides the faculty with a set of authoring tools, and other multimedia production equipment which aids in the development of the courseware. Combined with our existing video equipment, MIDPS augments our facilities to provide webcasting.

The Four Modes of Representation

Although the studio is designed to be in a multimedia environment, an important idea is to dampen the use of the computer as the central tool. The computer is considered on equal footing with all the tools in the toolbox. This is accomplished directly through assignments which emphasize the four modes of representing architecture. The notion of multiple representations of information is central to the course and is discussed thoroughly with the students at the beginning of the semester. Narrative descriptions of initial and final concepts are required, as are short written reports on field trips and research issues. Building class site models and chipboard study models in the traditional way—especially as a comparison to the 3D computer models—is emphasized. Students learn to study their work simultaneously via the computer models and via physical models and sketches to augment their visual perception and other cognitive skills. Research suggests that students relate to what they see on the screen better if they can relate it to previous experiences. (Roberts, et al) Our experience suggests that the shifting from one mode of representation to another, while difficult for some, offers the opportunity to broaden the perceptual understanding of the design problem and its solutions. Modal shifting also prevents the students from getting mentally fatigued by working on the project from one point of view. The most difficult shift occurs between the design mode and the analytical mode.

Final student projects are presented in two ways. The first, for an oral presentation of the project before a group of critics, designs are presented on traditional 'boards' which allows computer models to be rendered, printed, and thus communicated traditionally. This also gives the students the opportunity to mix their media, drawing on strengths and skills they may have previously acquired. The second mode of presentation is on the Internet both as digital images and as VRML models. To link these two methods we have experimented with webcasting the final review, both as a means of organizing the work and disseminating innovative methods. The first webcast was merely a window into the studio. Currently we are more prepared to modify our methods of digital presentation to meet the challenges of a new media.

The Results

The studio is presently being supported through funding from the National Science Foundation as *An Interdisciplinary Virtual Laboratory for Engineering and Architecture.* The studio was offered in the academic year of 1996 and the spring of 1997 as a pilot effort, and is operating currently as a "proof of concept". The following items have been implemented: 1) collaborative learning and design, 2) computer mediated environment, and 3) interdisciplinary teaching, coursework and design. Deep within this seemingly complex learning environment outlined are elements of the traditional design studio. The semester is divided into an analysis phase and a design phase with a few short research assignments interspersed. The goal is that the whole experience can be compressed into one semester. The current two semester sequence is designed to emphasize structural issues in the fall semester and building performance issues in the spring. Development of a preliminary syllabi quickly dispatched the idea that such a holistic approach could be accomplished in one semester until some experience has been gained in the development of the delivery system. However, the organization of the three academic units involved suggests implementing the course in one semester. The difficulty of a one semester course is that there is too much to learn and apply in one semester. Learning and application can only take place if the students have the proper preparation prior to enrolling in the course. Effecting one element of the curriculum is one thing; creating a downward ripple effect is another matter.

Collaborative learning

From the faculty point of view dividing the class into teams has two major effects: 1) on the downside, it increases management time to continually monitor the interpersonal problems which occur as people adjust to working together; 2) on the upside, it reduces the number of critiques and increases the time available for each critique. Moreover, it increases the students' effective working time because they need to manage each other and spend time in the studio discussing the problem and working together. In general, students are very favorable toward collaboration. Exit interviews and course evaluations indicate a strong interest in learning to work together.

The computer-mediated environment

The multimedia material is currently under development. Our project had access to adjacent mutlimedia projects and have benefited from that synergy.(Bengu 95; Bengu & Swart 97) The computer-mediated environment works as follows: Course material created on the word processor is converted to HTML, edited to add dynamic elements, stored on the server, accessed, displayed and disseminated through the browser. This provides the student and others continual access to all of the course material as it is posted and modified. Dissemination of course materials becomes seamless. Remote access and email allow the team members to work at a distance. The NJIT library catalog is also available at the workstation so that references to books and articles can be located immediately by the student.

We have found that it is imperative that faculty take a hands on approach to imparting computer skills. Comments from the students indicate they are more confident in the instructors who are hands on and display their skills directly rather than those who are more aloof and directive in their approach. The experience of the last few semesters suggests that teaching small groups of students detailed methods of access to the computer systems diffuse information among the students more rapidly than imparting the information to the whole class in a formal setting. The students learn more quickly in informal settings in which they are able to communicate directly with their peers. Research by Roberts et al also suggest that of the critical variables for productive learning, "the most important is the faculty's pedagogical style in their direct teaching and the student interest in the subject. The faculty must be sensitive to both the need to empower students exploration by providing them with the skills they need to explore... through direct teaching as well as allowing and encouraging students to do their own exploring." (Roberts et al) This requires continual observation of the skill acquisition of the students.

Problems

The development of TOTAL STUDIO is an evolving effort. The imprimatur of NSF funding has been a great aid to fostering collaboration among the academic units. A review of the four semesters of experience have yielded the following findings: 1) students are slow to conceptualize the multitasking potential of their workstations, and therefore under utilize the potential of the UNIX environment, 2) there are only a finite number of teaching hours in a studio and having to spend time teaching software subtracts from the time used for teaching principles of design, and giving individual design criticism, and 3) engineering students and architecture students organize their work and their thought processes in an entirely different manner which will require further analysis and adjustment on the part of the faculty.

While working on teams is generally not part of the studio culture, most teams have operated successfully in recent semesters. The reason for lack of success in teamwork seems to be based on the conflict in personality, differences in work ethic and habits, the lack of experience in working on teams, and a mismatch in skill levels between team members. In anonymous evaluations, the students commented that "I liked the team thing as an idea. It didn't work out for me though because I had a hard time with my partners. I do think in the future, team design is a good idea." Or "Groups of peopled helped but caused many disagreements which slowed down progress. Although the thought of putting people together was a good one." The extended history of the studio as a collaborative one aids in the development of teamwork because it generally excludes students who might undermine the concept.

Conclusion

The metaphor, changing the culture of the curriculum, may seem slightly pedantic; however, methods of teaching have been passed from generation to generation in the most unquestioning manner. New technologies, as precursors of changing methods, are often resisted. The efforts to change, sometimes abetted by the layers of accrediting organizations, are held back by the 'viscosity' in the organization. Creating a change that evolves, rather than changes abruptly, gives the results an opportunity to become integral to the culture and reaffirmed by tradition. Our team of faculty expect criticism from our colleagues, from professional organizations with long standing paradigms and vocabularies holding antithetical views, and even from the students. We are abetted by the support of outside funding, and the interest of professional organizations, both of which add an imprimatur to our efforts. At the core of our activity is the goal of helping to "lead the professional to a future of greater relevance and responsibility." (Mitgang 97 p. 124)

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Architectural Aspects of an Interactive Multimedia Environment for Teaching Chemistry in Secondary Education

John Garofalakis
Ioannis Hatzilygeroudis
George Papanikolaou
Spyros Sioutas*

Department of Computer Engineering and Informatics
University of Patras, 26500 Rion, Patras Hellas (Greece)
and
Computer Technology Institute,
Kolokotroni 3, 26221, Patras, Hellas (Greece)

garofala@cti.gr
ihatz@cti.gr
sioutas@ceid.upatras.gr
gpapanik@ceid.upatras.gr

Abstract: In this paper we present a multimedia-based system that facilitates teaching chemistry to pupils of Hellenic (Greek) high schools over a LAN. The system uses a variety of multimedia objects. An important aspect of the system is the central control the teacher can have over some aspects of a lesson. So, the teacher can enable the section to be taught and disable the rest ones, and design and deliver on-line tests to the pupils. The pupils are then able to submit their answers to a central database. This is achieved by using dynamic hyperlinking implemented as remote SQL queries over a LAN.

1. Introduction

Over the past few years, new technologies have been used in producing educational tools. The use of multimedia technology has given a great impetus to the training evolution in education. Multimedia systems provide an integrated environment for the creation, storage and presentation of a variety of media types (e.g. text, graphics, video and audio) enabling the development of a great number of successful prototype educational applications (Hopper 1990), (Fox 1991), (Narasimhalu & Christodoulakis 1991), (Faconti 1994).

In most cases, information technology is concerned with heterogeneous data both static and dynamic. Existing LAN (Local Area Network) development tools support efficient solutions for the integration of multimedia interfaces (static information) and database systems (mainly dynamic information) with impressive results (Narasimhalu & Christodoulakis 1991).

Today in Hellas (Greece), computer technology (e.g. multimedia systems) is not extensively used for educational purposes in subjects other than informatics in Secondary Education. When used, it is usually done on stand alone computer systems. However, due to recent introduction of LANs in computer labs in Hellenic high schools (Garofalakis et al. 1998), the need for educational software that exploits LAN capabilities has been arisen.

This paper presents the architecture of an interactive multimedia-based environment to be used as an assistant for teaching chemistry in a classroom over a LAN. It incorporates a multimedia application, for manipulating static information, and a relational database, dealing with dynamic information. These two components intercommunicate via an application server over a LAN. The end-users (teacher and pupils) can access corresponding available information (static and dynamic). The static information resides in the multimedia

* The order of the authors is alphabetical.

application and is to be used during a chemistry course. The dynamic information is related to the tests designed and delivered by the teacher and the answers given by the pupils and resides in the database.

The paper is organised as follows. Section 2 presents the abstract architecture and design aspects of the system. Its functionality and interaction with the users are discussed in section 3. Section 4 deals with the implementation aspects of the system, while the last section, Section 5, presents the conclusions drawn and directions for further work.

2. System Description

The system is composed of three basic components (see Fig. 1), the *multimedia application*, the *application server* and the *relational database*. The multimedia application (front-end) interacts with the human users and the administrator of the system. The application server acts as an intermediate between the multimedia application and the database by conveying queries from the former to the latter over a LAN. The database (back-end) accepts data from various sources (mainly dynamic information), processes it, stores the results and pipes it to the front-end, when requested.

The system topology is illustrated in Fig. 2, where the front-end and the back-end of the system are indicated. The database resides on the central PC of the LAN (server), whereas a copy of the multimedia application and the application server exists on each of the rest PCs (clients).

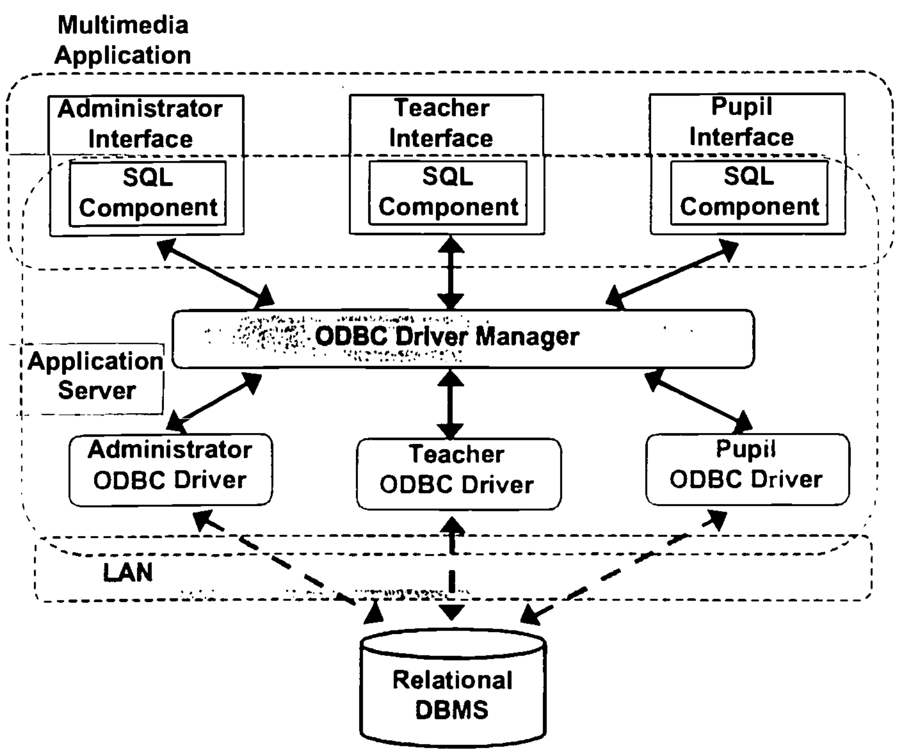

Figure 1: The architecture of the system

2.1 Multimedia application

The static information provided by the system is included in the multimedia application and presented in a variety of ways, such as hypertext, special sounds, appropriate images and animations, hypermedia object, educational games or quizzes, video recordings of real chemical experiments and interactive simulated chemical experiments. Every screen follows one of some predefined presentation screen patterns. Common to all, on the top area of the screen the logo of the application, at its left, and the title of the specific section or subsection, at its right, lies. Also, at the bottom of the screen, there are several buttons (or options) facilitating the interaction between the user and the application. The main content is displayed at the central area of the screen, the active screen (see Fig.3).

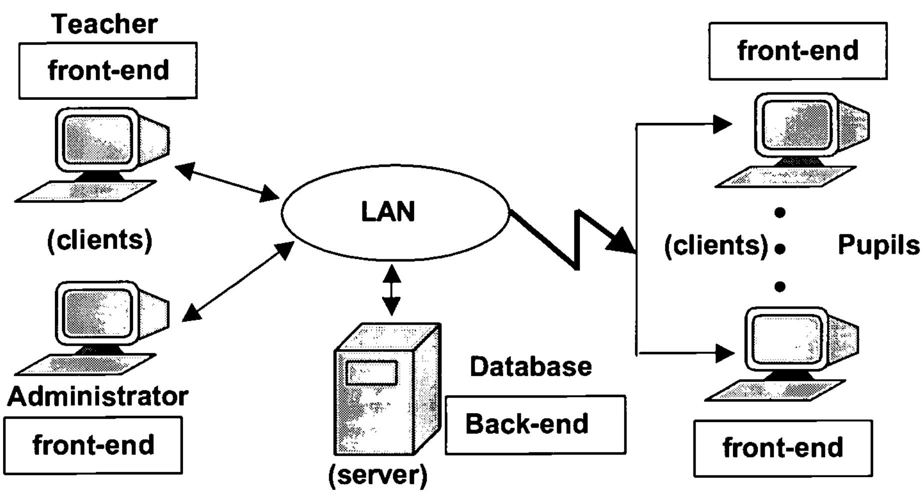

Figure 2: The topology of the system

Figure 3: A screen for topic selection in a subsection

Navigation scheme is a mixture of the hierarchical and linear models. The content is distributed in sections, subsections and topics. Its topic comprises a series of screens containing information in any combination of the above mentioned ways of presentation. The user determines the presentation flow in a degree, by using hot area selections as well as buttons. For example, in Fig. 3 there are three hot (selection) areas, one for each of the three topics. On-line help is available, usually via messages at the bottom of the active screen, where necessary, thus making use of the system as simple as possible to even a novice user.

There are different components of the interface of the system (front-end), related to the administrator and the end-users (teacher and pupils) of the system. These components are related to the user views, described in section 3. The interface of the multimedia application allows use of both the static and the dynamic information. Access to dynamic information is achieved via *dynamic hyperlinking*. That is, links to objects are defined not as local references but as remote queries to the database. This means that some hyperlinks are established dynamically, at run-time, assuming that the information is structured appropriately in the database. This reduces the cost of static hyperlinking and results in ease of tailoring, since it permits data/schema update and evolution (needed for on-line applications) via the database. In addition, it makes the presentation stable, since the hyperlinked objects are subject to the integrity control of the database.

Dynamic information concerns a) activation of the section to be taught and deactivation of the rest ones, b) creation, modification and selection of multiple-choice type questions for each section to form a test, c) storage of the answers of the pupils to the test and d) access authorisation checking.

2.2 Application Server

The Application Server comprises the ODBC Driver Manager, the SQL components and the ODBC drivers. SQL queries to the database are directed via the ODBC Driver Manager to the corresponding ODBC driver and then to the database. ODBC Driver Manager is necessary in case we have more than one ODBC driver for each of the administrator, the teacher and the pupil. This happens when we have more than one database or database partition. In case we have a single database, ODBC manager degenerates to direct connections of the ODBC drivers to the corresponding SQL componenents.

The three components of the SQL server, that are related to the user views (section 3), are as follows:

- **SQL component for the administrator:**
  This component is responsible for the security of the system, since it enables the administrator to establish passwords for the pupils and the teacher. The passwords are stored in the database. It also deals with database updates.
- **SQL component for the teacher:**
  This component allows the teacher to take control over some aspects of a lesson. The teacher can enable the section to be taught and disable the rest ones. Also, it allows the teacher to handle the set of the test questions. He/she can insert new questions, modify existing ones, delete old ones and select a subset of them to set up a particular test.
- **SQL component for the pupils:**
  This component is responsible for checking pupil identification, by examining their particulars, like name and password. Also, it has the task of on-line delivering the test designed by the teacher. Finally, it is responsible for recording the answers of the pupils in the database.

It is the last two components where dynamic hyperlinking is mainly used.

3. User Views

We can distinguish four different ways information can be viewed, that is four basic views, as far as the users are concerned:

- **General view:** In the general view, the user can access all available chemical information by navigating through the sections, subsections and the topics of the multimedia application. For this purpose, the screen is divided into hot spots (specific regions) for every section or subsection and the user can select a specific region and access the related information (Fig. 3).
- **Administrator view:** In the administrator view, the user can establish passwords for the users of the system and update information in the database.

- **Teacher view:** In the teacher view, the user is able to specify the content of a lesson, design and insert new questions in the question set, select a subset of the existing questions and deliver it to the pupils and view their answers.
- **Pupil view:** In the pupil view, the user can identify himself/herself to the system and answer to the test questions that have been delivered by the teacher.

The administrator of the system can use only the administrator view. The teacher can use the teacher view, the general view and the pupil view, whereas the pupil can use the general view and the pupil view. A third person can use only the general view.

4. Implementation aspects

The system, in the form of an advanced prototype, has been developed under the Windows 95 operating system and has been tested on a variety of workstations. The multimedia application was developed using the Macromedia Authorware and Macromedia Afterburner authoring tools that use icon-based scripting. Some additional code was written using Visual Basic.

The database application was developed using the Access RDBMS. The image format is BMP while the videos are formatted as AVI and compressed using the Intel Indeo(R) Video R3.2(32) encoder. The animations are formatted as AVI files as well. Finally, any sounds were digitised and compressed into WAV files.

The application that handles the communication between the user interface and the database comprises a number of SQL components. In particular we used the ODBC functions (ODBCOpen, ODBCClose and ODBCExecute) that Authorware offers for opening a database, closing a database and executing insertions, deletions and updates respectively. These functions are called via calculated icons. Dynamic hyperlinking is implemented by connecting Authorware parameters to database items.

5. Conclusions and further work

In this paper we present the architectural aspects of a multimedia–based system that facilitates teaching chemistry over a LAN to high school pupils. It enables a high level computer-based teacher-pupil interaction using multimedia and hypermedia technology.

An important feature of our system is the use of dynamic hyperlinking, which facilitates on-line control in some aspects of a lesson by the teacher. The teacher can disable all irrelevant sections, so that the pupils cannot "play around" the application, but concentrate on the specific section. Also, the teacher can design new questions, review or delete old ones and select which questions will form a test for a certain lesson. All these are done from a unified user interface, offering different views to different users.

We intend to improve our system in two directions. One concerns extension of the flexibility of the teacher, in making changes to the content of the application other than to questions, such as to text, images, videos etc, in a predefined way. To this end, object-oriented database and authoring technologies may be used (Thuraishngham 1992). The other concerns use of the application over the Internet, additionally equipped with teleconference capabilities to provide a kind of a virtual high school class (see e.g. Hiltz & Wellman 1997). To this end, a number of technical problems should be solved (Wilson 1994).

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Design Patterns in Educational Hypermedia Applications[1]

Neide Santos[2] neide@cos.ufrj.br

Fernanda Campos[3] fernanda@cos.ufrj.br

Luis Mariano Bibbo[4] lmbibbo@sol.info.unlp.edu.ar

[2, 3] COPPE/Sistemas/UFRJ and Dep. de Ciência da Computação Universidade Federal de Juiz de Fora
Rio de Janeiro - 21 945 270-PO Box 68511 - Brazil
[4]Laboratorio de Investigación y Formación en Informática Avanzada
Universidad de La Plata - 11-1900 - La Plata - Argentina

Abstract: Educational hypermedia authoring process remains as a critical point. This kind of application can assume different formats depending on the chosen learning focus. To build a system of patterns, we analyzed contemporary theories and drew two hypermedia categories: exploratory discovery and guided navigation. We identified the main modeling problems related to the formats and write corresponding solution, using design patterns concepts. We are finishing and refining the patterns and describing others to compose a system of patterns for educational hypermedia modeling.

1. Introduction

Building hypermedia-based educational applications is not easy. Besides a multidisciplinary team, an educational application must reflect the chosen educational goals and the learning environment. Learning environment must be specified *a priori* in educational software life cycle, and it mirrors an educational philosophy and the elected learning theory. However, expert educators and hypermedia designers never build their new applications from scratch. They usually reuse successful ideas they have used in the past. In traditional model of education, pedagogical strategies and goals are imposed by designers. Now, Constructivism is in the front end of the education, and designers can not impose a specific learning model but allow students to construct their own knowledge. While traditional instructional design is based on a linear and hierarchical relationship, new instructional design aims to allow students to select and develop their own strategies, searching for new knowledge domains. Our research is to develop patterns for modeling educational hypermedia applications, considering that instructional technologies are now centered in the process, looking forward for interactive learning environments creation. Intended goal is to obtain a satisfactory formal level, so it can be reused by teachers and hypermedia designers.

This paper presents a set of navigational patterns for helping educational hypermedia designers. The work is organized as following: section 2 briefly discusses learning theoretical foundations to construct educational hypermedia scenarios; section 3 shows how to minimize problems met in developing educational application, using concepts of design patterns. Conclusions and future works are pointed out in the last section.

2. Learning Theoretical Foundations

In the nineties, changes in education focus can be pointed as a remarkable fact. The challenge, today, is to design computational environment to support the knowledge construction, instead of continuing to develop software based on contents memorization and repeatness. The breaking up with overshot issues has brought out important impacts on educational software. New instructional design encapsulates hypermedia features, as the non linear format and the free choice of navigational paths.
Moreover, educational hypermedia can adopt different pedagogical formats, such as impromptu discovery, free exploratory discovery, guided navigation and navigation over enchained sequences of information. To support these formats, learning and methodological guidelines must be available to help designers' work.

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Learning theories reflect dichotomous visions of how the learning process happens. On one extreme, there are the closed approaches, such as the Behaviorism viewpoint and, on the other extreme, there are the opened approaches, such as the Socio-Interactionism. Between them, we can outline Gagné's Neo-Behaviorism and Piaget and Bruner's Constructivism.

Behaviorists consider individuals a passive organism, governed by external environment stimulus. Learning is a permanent change in a specific behavior. Behavior is only what can be externally observed and measured, and it only changes facing reinforce contingencies.

Neo-Behaviorist theory also considers the learning an external behavior, which can be observed and generate permanent changes. Moreover, in the theory scope, mind internal functioning is considered. Gagné is the most representative theorist of Neo-Behaviorist school and to him learning is a behavior change, followed by changing permanency. Learning can be activated by a large range of stimulation from individuals interaction with external environment. The stimulation is considered the learning process's input, able to produce behavior changes, observable as human performance - the output. Intellectual skill complies with a hierarchical sequence: from simple chains, concepts and rules to problem solving. Simples intellectual skills can be composed of simplest skills, that are their pre-requirements, resulting in a skills frame, called learning hierarchy.

Constructivist school considers that learning process is a (re)construction inside individuals, through external environment interactions. The student is the active agent in the learning process, experimenting, researching, questioning and developing the reasoning. Teacher must play, at same time, the role of the learning facilitator, moderator, promoter and challenger of new experiences and must be able to propose strategies and ways that allow students to search and find answers. Piaget and Bruner are important ones in Constructivism school. An usual criticism to Piagetian Constructivism is referred to learning as individual construction viewpoint. Constructivism seems to be uninterested with cultural and social conditionings. Vygotsky is the most representative theorist of learning as a social construction, done by the history and by the culture.

Socio-Interactionism theory points that thoughts are gradually built on a historical and social environment. Social interactions play fundamental role in cognitive development. Development always happens firstly in social setting, among people, and after in the individual setting, inside himself. The child faces three cognitive development stages, extensible to all learners: real development level - determined by individual capacity of solving independently problems; potential development level - determined by individual capacity of solving problems, under supervision of more capable individual or in cooperation with more capable peers; and zones of proximal development - intermediate development stage, situated among real development level and potential development level. Zones of proximal development can be improved through social interactions, i.e., adult help or peers cooperation can develop intellectual skills.

It is complex to draw educational events strictly based on theoretical foundations, but it much more complex to develop educational software under these foundations. Applying theoretical basis in the development of traditional educational software never was usual, since the development process always was *ad-hoc*. Therefore, there are a new scenario - the diffusing of educational hypermedia applications and, more recently, the increasing hypermedia publishing on the Web. It is requiring both theoretical and methodological supports to all development phases, mainly to earliest ones. Educational software designers need to understand the learning process, to integrate, since the beginning of the development, a consistent view of how and under which circumstances people learn.

Behaviorism and Neo-Behaviorism theories are concerned to facts memorization, through the absorption of small and enchained information portions. Constructivism hypothesis is concerned to learning by doing and by acting and transforming the environment, through intellectual challenges and puzzles. Socio-Interactionism rationale is concerned to peers' collaboration, where the "more capable peer" helps the other peers to overcome current knowledge lacking. Behaviorism, Neo-Behaviorism and Constructivism conceive the learning process as an individual process, while the Socio-Interactionism understands it as a historical, temporal and collective process. Navigating over small pieces of enchained information is typically an educational hypermedia application based on the Behaviorist approach. Guided navigation and navigating for hierarchical paths can be seen as an educational hypermedia application based on the Neo-Behaviorist approach. The impromptu discovery, through the free navigation on the Web, the incidental learning, and the exploratory discovery are typical formats of educational hypermedia built under the Constructivism point-of-view. Navigation based on cooperative work, on intense peers' collaboration and on the assumption of learning is a social and shared process are educational formats adopted by the Socio-Interactionism approach.

Not always educational hypermedia applications can be modeled under determined theoretical foundations. Piaget and Vygotsky approaches can not be modeled according to traditional instructional design techniques. These approaches emphasize opened ways of navigating, that can not be modeled. When we try to model these approaches, we often make them closed, contradicting the theoretical principles. On the other hand, educational hypermedia based on Behaviorism foundations can be easily modeled. Moreover, this approach is outdated, proposing poor and limited instructional events.

3. Design Patterns in Educational Hypermedia Modeling

A pattern is the abstraction from a concrete form that keeps recurring in specific non-arbitrary contexts., the notion of a pattern is geared toward solving problems in design. A pattern is more than just a battle-proven solution to a recurring problem. The problem occurs within a certain context, and in the presence of numerous competing concerns. The proposed solution involves some kind of structure that balances these concerns, or "forces," in the manner most appropriate for the given context. Using the pattern form, the description of the solution tries to capture the essential insight that it embodies, so that others may learn from it, and make use of it in similar situations. The pattern is also given a name, which serves as a conceptual handle, to facilitate discussing the pattern and the jewel of information it represents. So a definition that more closely reflects its use within the patterns' community is: a pattern is a named nugget of instructive information that captures the essential structure and insight of a successful family of proven solutions to a recurring problem that arises within a certain context and system of forces. From this background, we describe a set of patterns related to problems met in educational hypermedia.

We have studied the authoring process of educational hypermedia applications under two learning theories - the Bruner's Constructivism and the Gagné's Neo-Behaviorism. These approaches can be modeled, because both Bruner and Gagné have an instructional theories. To start the building of a patterns system we firstly selected two educational hypermedia categories: the exploratory discovery based on Bruner theory and the guided navigation, based on Gagné assumptions. Second, we identified the main modeling problems related to the two formats. Then, we were able to write down our patterns.

Independently the chosen learning theory, a new hypermedia design problem arose due to the increasing publishing in the Web: the Internet functionality. For each problem, we present a pattern, using design patterns concept. The patterns are composed of a name, a brief description, the problem, the related forces, the proposed solution and the known uses. Our work is a work-in-progress yet, since some patterns have not achieved the necessary formalism. Moreover, we are completing and refining the written patterns, aiming to test and validate them. Other related patterns will be described, in order to compose a preliminary pattern system for educational hypermedia modeling.

At the moment, we wrote six patterns: Avoiding disorientation and Minimizing cognitive overhead, concerning the Exploratory Discovery Pedagogical Approach, Enriching Navigational Paths and Improving browsing, concerning the Guided Navigation Pedagogical Approach, Minimizing answer time and Assuring access to informational links, concerning the Networking Functionality.

Navigation in Exploratory Discovery Pedagogical Approach

Navigation in exploratory discovery pedagogical approach provides student only the educational goals and the navigational spaces. The advantage met in this approach often becomes a serious problem, since student can get lost, feeling disoriented and presenting cognitive overhead. As solution, we propose the patterns "Avoiding disorientation" and "Minimizing cognitive overhead"

AVOIDING DISORIENTATION

Description: This pattern is addressed to avoid user's disorientation in educational hypermedia applications based on free discovery.

Problem: How can we avoid that the user get lost in an educational hyperspace?

Forces - Hypermedia users get lost with poorly structured information landscapes and without appropriate navigational tools. Incidental learning should be maintained, since it is an important and fun way of learning. Navigational space should be maintained, but the student can improve his/her learning environment. Navigational design should allow the use of cognitive strategies related to solve problems and take decisions. Collaboration and communication among peers are important educational issues. Social knowledge construction is a relevant point for the new world social organization

Solution - Incorporate navigational facilities to the hypermedia design to provide the accessing to relevant nodes and informational contexts. Use graphic spatial representation to aid the user's orientation and bookmarks, annotations, navigational maps (local and global) or conceptual spaces of navigation, searching by meaningful keywords to orient the browser. Dispose cooperative virtual spaces and browsing tools. Consider the available platform during the design phase. If the design is for the Web, frames, navigational paths, pathfinders, HTML form for annotations, search engines are practical solution. On stand-alone platform, navigational paths, no ambiguous interface solution and annotation individual notecards are effective solutions.

Known Uses - Museums – Le Louvre and Library – Internet Public Library - http:// www.ipl.org/ref/

Related patterns: Minimizing Cognitive Overhead

MINIMIZING COGNITIVE OVERHEAD

Description: This pattern is addressed to avoid student's cognitive overhead while browsing in information landscapes.

Problem: How can we design an educational hypermedia to avoid that time demands becomes high and the student becomes unmotivated, fells lost and the educational goals fail?

Forces - Besides the challenge of solving proposed problems, the student faces the navigational design when browsing an educational hypermedia. Cognitive overhead happens when the student does not feel how the informational space is organized, its depth and extension. Incidental learning should be maintained, since it is an important way of learning and fun. Exploratory opportunities should be preserved.

Solution - Plan the hypermedia design using facilities in order to provide access to relevant marks. Use pathfinders, search engines or mechanisms, index, embedded menus, bookmarks, annotations, navigational maps. Index, embedded menus and accessing keys resolve partially cognitive overhead problems. Key points must be signed by special marks.

Known Uses - Museums – Le Louvre and Library – Internet Public Library- http://www.ipl.org/ref/

Related patterns: Avoiding Disorientation

Guided Navigation Pedagogical Approach

In guided navigation, instructional contents are offered in little portions, though embedded menus. Entry encyclopedia and text book are the metaphors commonly adopted. Students exceptionally get lost, but their navigational spaces are very restricted, causing lack of motivation. As solution, we propose the patterns "Enriching navigational paths" and "Improving browsing".

ENRICHING NAVIGATIONAL PATHS

Description: This pattern is addressed to enrich navigational paths to improve the learning environment and the student choices.

Problems - How can we guarantee that powerful navigational paths are offered?

Forces - Very restricted information landscapes make the student gathers inappropriate range of knowledge. Guided navigation guaranties that the relevant paths will be browsed

Tours, tracks and pre-defined paths are typical design decision in this approach. It assures user's orientation and can help educational goals achievement. If the educational goals are related to improve skills and to solve very specific tasks, this approach can be useful

Solution - Take in count the possibilities of the student to expand the learning environment by himself, offering additional information. Make sure that an alternative path always return to the main one. Learning environment enrichment can be reached by offering paths with additional information. Additional information paths must be planned and linked to the main path.
Known Uses - Education – Cooperative Distance Learning - (http://venus.rdc.puc-rio.br/kids/kidlink/acd/acd_index.htm)
Related pattern: Improving browsing

IMPROVING BROWSING
Description: This pattern is addressed to improve browsing possibilities in guided navigation approach, in order to enrich the information landscapes.
Problems - How can we avoid poor browsing and restrict learning environment in a guides navigation approach?
Forces - Guided navigation assures user's orientation and often do not cause cognitive overhead. This pedagogical approach that supports this kind of learning often lets the student boring and unmotivated. When the hypermedia planning is based on closed tours, it may result in a poorly browsing, restraining the learning environment Tours, tracks and pre-defined paths assure user's orientation and can help educational goals achievement. If the educational goals must be reached, guided navigation is a good design decision. If the educational goals are related to improve skills and to solve very specific tasks, this approach can be useful. A guided navigation guaranties the accessing to main path related to the problem solving. Time demands to find and retrieve effective information is short.
Solution - Costume the browsing considering learning speed, learning context (levels), individual annotations of documents. so the student can feel responsible to some decisions taken. The designer must take in count the student's possibilities to expand the learning environment by himself, offering them additional information choices. It must offer navigational level portraying a range of choices to students with different knowledge and skills, at distinct moments. It must use a comprehensive set of navigational tools, such as personal notes, reports and databases facilities to individualize the navigation.
Known Uses - Education – Cooperative Distance Learning (http://venus.rdc.puc-rio.br/kids/kidlink/acd/acd_index.htm)
Related pattern: Enriching navigational paths

Networking Functionality

The Internet is growing fast and becoming more and more sophisticated. It brings out serious problems, such as long answer time, links cut and access denied. As solution, we propose the patterns "Minimizing answer time" and Assuring access to informational links

MINIMIZING ANSWER TIME
Description: Due to current networking bandwidth, informational links often present a long answer time. The user becomes boring, unmotivated, frustrated and anxious. It makes the user jump the node and choose another link.
Problem - How can we minimize the long answer time when we access a informational link?
Forces - The answer time delay can be minimized if the users know what is going on with the information retrieval.
Solution - If the link belongs to the application scope (internal link), the designer must analyze the media benefits (video, animation, images) to decide about its importance to the users interaction and learning process. The designers can use smaller images, with low/medium resolution, use small video sequences. If the link is Web-site (external link) the designer must provide information about the time spent for information retrieval. He can also give the user the choice of accessing or not the information. Moreover, he should provide similar information as internal links.

ASSURING ACCESS TO INFORMATIONAL LINKS
Name: Internet functionality
Description: Some Internet functionality can get the user lost and confuse, since he can meet cut informational links, with access denied and with different interfaces layout.

Problem - How can we avoid that the user get lost and confuse facing not linked informational nodes, denied access and different interface layout?
Forces - All users can publish and cut out pages in the Internet, at any time. The page belongs to him, so he can also deny the user's access any time. The Internet is in frequent changing, with the addition or suppression of links. Moreover, its dynamism is a useful feature for gathering new information.
Solution - For each particular situation use one of the solutions below: Link cut - store external links and information into databases in its server. Therefore high storage cost, lost of performance and maybe requires a hard programming step or phase. Access denied - be sure that all external links are available. If the links were not available after implementation, find and present similar links. Interface layout - search sites with simple and clear interface layout and that do not confuse the user or make him tired. Final solution to the Internet functionality related problems will only come with network stability and the definition of clear access rules.

Conclusions and Future Works

Changing on the educational process focus has impacting educational software development. Now, software design must encapsulate hypermedia features, but educational hypermedia applications can assume different pedagogical categories. To support the new scene, learning and methodological guidelines must be available to help designers' work. An accurate authoring process of educational hypermedia applications can result in an appropriate navigation. In this sense, we are proposing a meta-model for helping all phases of the authoring process plus a set of pedagogical guidelines expressed as design patterns. Developers and teachers care for this conceptual information and the pattern system will be reused according to specific need. Our work is a work-in-progress, moreover, we are finishing and refining the written patterns, aiming to test and validate them. Other related patterns will be described, in order to compose a preliminary pattern system for educational hypermedia modeling.

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Distance Learning and Working over High Speed Internet

Riitta Rinta-Filppula

CERN

Switzerland

riitta.rinta-filppula@cern.ch

Abstract: Web University (WU) is a project based on the concept of virtual university where distance participants communicate over networks by using applications such as email, World Wide Web (Web), multicast interactive videoconferencing and video-on-demand. The project uses national research networks and European wide high speed Internet connections.

The Web University started as a collaborative pilot project between CERN and Finnish universities and extended to other countries in 1998. This article describes how the WU-pilot has used public domain software for creating interactive, real time distance learning and working environment and video-on-demand services on FUNET (Finnish University and Research Network). The WU-pilot has tested and applied new technologies to the service of distance learning and working as efficiently, user-friendly and economically as possible.

1 Web University (WU) project

1.1 Goals and background

The Web University project (WU) works as a virtual university. It started on transferring the latest results of high-energy physics directly to universities. Physics researchers can update their knowledge by participating in CERN (European Laboratory for Particle Physics) [1] seminars and experiments from their personal workstations over real-time broadband network based on ATM (Asynchronous Transfer Mode) and Internet technology. Teaching is interactive and it is in principle targeting researchers and postgraduate students, but some courses in physics and information technology have been additionally offered to undergraduate students and special groups, such as journalists and general public.

The participating universities have selected lectures and seminars from the WU home page [2] on the World Wide Web (Web). WU has transmitted the lectures by the means of real-time videoconferencing from CERN to participating sites over the European and national broadband research networks. These transmissions have been

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[1] CERN home page http://www.cern.ch/

[2] WU home page http://wwwcs.cern.ch/, projects, Web University

interactive. In addition, the learning has been independent of place and time because the real-time sessions have been recorded on a server. All the time, WU has tested and used the latest technology.

Distance work has been started with user tests, where the supervisor observes and communicates with test users over the network. The supervisor has been at CERN, in Switzerland, and the test users in Helsinki Institute of Physics, in Finland. These user tests have been part of the development and evaluation work of a Web based document management system (more Eronen 1998).

The WU project started as a collaborative pilot between CERN and Finland in 1995. Since 1997, the activities in the WU project at CERN were planned and conducted in collaboration with Finnish distance learning projects, Finnish Distance Learning in Multimedia Network project (ETÄKAMU, 1996-1999) and Finnish Open Learning Environment (OLE, 1999-2002). Since 1998, the real-time sessions have been transmitted at the same time to Finland, Italy, Holland and Slovak.

In particular, the following Finnish companies are funding the WU project: Technology Development Center (Tekes), Center for Scientific Computing (CSC), Helsinki Institute of Physics (HIP) and HPY/ Finnet Group. CSC is the enterprise of the Ministry of Education and it is operating the Finnish University and Research Network (FUNET). Helsinki Institute of Physics coordinates cooperation between CERN and Finland and does high energy physics research in Finland.

WU is open to all universities and research centers to participate. So far, real-time distance participants have been from the following 11 universities and institutes: in Finland, the University of Helsinki/Helsinki Institute of Physics, Helsinki University of Technology, the University of Jyväskylä, Tampere University of Technology, Pori School of Technology and Economics, the University of Oulu and Oulu Institute of Technology; in Holland, the University of Twente; in Italy, the University of Rome 2 "Tor Vergata" and the High Energy Physics Laboratory of Pisa and in Slovak, Pratislav University of Technology.

1.2 Communication networks

The Web University project started by transmitting CERN lectures to Finnish universities over ISDN but since June 1996 the videoconferencing has been done over IP/ATM, as that was when the European Commission launched its telecommunication programs based on broadband network services.

The Web University project became a customer of JAMES (Joint ATM Experiment on European Services) in 1996 and used a point to point connection with a communication speed 1- 2 Mbps between CERN in Switzerland and Helsinki in Finland. Since 1998, WU has used TEN-34 and TEN-155 and the seminars have also been transmitted to Italy, Holland over TEN and to Slovak over a private network.

The lectures were multicast in each country by the national research network operators. FUNET, the Finnish University and Research Network has multicast lectures to universities in Finland. The communication speed of the FUNET backbone network is 155 Mbps and mainly based on ATM.

1.3 Software

The learning and working environment of WU is based on tools of the MBONE technology. At the beginning of the project, the connection for the real-time videoconferencing was created manually by Rtptrans software and digital recordings were also done manually. Since the autumn 1998, the connection has been created automatically by the Virtual Room Videoconferencing System (VRVS). VRVS is Web based and it is being developed at CERN. Digital recording and playback have also been done by VRVS. The recordings have been copied to the WrtpVod server of FUNET for retransmissions on demand.

1.4 What do you need to participate in WU?

The project discovered that *every country*, that wants to participate in WU, requires:

1. Universities and research centers, which are connected to the European academic and research infrastructure and are willing to join the project. These universities should be interested in using or producing freely available courses as part of an academic distance curriculum. Moreover, these universities and research centers should be

motivated to receive or distribute the latest research results and support local costs.

2. At least one technical person and one educational contact person, who co-ordinate activities in the country. The technical contact person should be involved with a national network provider.

3. A technical contact person and an educational contact person for each institute.

2 Results and conclusions

CERN is a research laboratory where the best specialists of scientific institutes and universities often come to give lectures. WU has made these seminars available for researchers and students in remote universities. Moreover, it has enabled researchers and their students even at small universities to attend the CERN seminars from their own university. They can participate in interactive, real-time seminars from their personal computers or local auditoriums and ask questions from the lecturer either as the audience at CERN or by using email. WU has transmitted more than 100 hours of different kind of lectures and seminars to the universities. If participants are occupied during the real-time session, they can study the subject by using the video-on-demand service of FUNET some hours later when the time is convenient for them.

In this context, WU found out how to make a successful distance learning session by studying distance students' attitudes and by evaluating distance learning (Rinta-Filppula 1998).

These findings proved that, at the beginning, the pedagogical expectations should not be too high, as the students need time to adapt to a new situation and learning environment. In addition, it turned out that it is difficult create an interactive distance learning session because a lecturer and distance students are different every time and to thus, they do not know each other.

It appears that undergraduate students need academic credits as a motivator but postgraduate students, on the contrary, are interested in the latest research results even without getting any. Academic freedom gives students many possibilities to select study courses. Undergraduate students are unlikely to be willing to spend their time looking at a video screen and studying in a foreign language, English, if they do not get any credits.

2.1 How to make face to face studies successful distance learning

Distance learning sessions can be planned for distance learning or they can be a part of face to face learning, where the students participate over networks. This article concentrates on the latter case, where it is very important to provide lecturers with preliminary information about the distance students in order to give them a possibility to adapt their lectures for the distance learners. The feedback collected has shown that the lecturers should more commit themselves to adapt their presentation for distance participants. On the other hand, the lecturers would need support and help how to apply the technology from pedagogical point of view.

Distributed real-time sessions are differently. Distance participants have proved to be especially satisfied if the speaker is well-known (e.g. a Nobel price winner or a Web inventor) and they can communicate real-time with him or her. In addition, they can later integrate the presentation to their teaching or studies because it is available on the network based multimedia service.

Flexible learning should be planed different if the distance learners are allowed to include the sessions to their studies and obtain credits. In this case, learning process should start before the real time session to enable to take full advantage of the possibilities that modern learning theories and technology provide. This can not happen without an agreement and cooperation of a local teaching staff in a distance institute. A network base multimedia service built on video-on-demand service, course discussion channel, knowledge exchange of the best practices of distributed programs etc. is an essential part of distance learning but even more important is to develop and adapt teamwork and active learning methods to new high speed network environment. This can take place for example, as follows:

A lecturer who will give a presentation in a real-time session publishes his abstract and reference material on the Web in advance. In distance universities, a local teaching staff and their students agree on draft plans of distance student teamwork, work methods and evaluation. The drafts will be published on the Web in a course discussion channel. The students study the reference material before the interactive, real-time session gets started. After the session, the plans of the distance groups will be published on the Web and the students will work with their group presentation papers by using teamwork tools, project tools etc. They will then publish their papers on the Web and present them in a real-time virtual seminar, where they also will act as opponents to the other students. This is not only an excellent possibility for students to practice project and teamwork but also planning and giving a presentation in an international conference. In addition, through the student works, the teachers can enrich their teaching methods. After a virtual seminar, the students will publish the second part of their distance work, i.e. the evaluation. It can consist of e.g. a report of their work progress, their individual, as well as group analyses of what they have learnt, their group analysis about learning and work practices and recommendations for getting better learning results. It should be noticed that the students are constantly expected to pay attention to justify their opinions, in order to derive full advantage from the learning process.

The virtual learning described above can take place only in universities (e.g. Finnish universities and the university of Twente in Holland (Collis & Fisser 1998)) where the teachers have applied teleteaching, teamwork tools, project learning and other active learning methods as a part of their curriculum. The pedagogical background of the model lays on the seven properties of meaningful learning (Pohjolainen 1999) that are suitable for lifelong learning – from comprehensive school to university level and to adult learning – independent of time and place. This kind of virtual learning carries out the active learning (Jonassen 1995).

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Copyrighting Cyberspace: The Digital Millennium Copyright Act

Robert N. Diotalevi, Esq., LL.M.
Director of Legal Studies
The College of West Virginia
PO Box AG
Beckley, WV 25802
304-253-7531, x1375
E-mail: bobd@cwv.edu

Abstract

The Internet is the largest computer system. The net or cyberspace provides much useful information as we navigate URL's, browsers and hyperlinks. With advanced technology comes new legal issues to battle. Copyright law is at the forefront of cyberspace debate. Thus, we need to examine and stay abreast of issues so important to all those being affected by this area of law.

In this work I will endeavor to explain the latest legislation regarding copyright in cyberspace. I hope that such information will prove to be a resource as well as a guide to all those interested in traversing these navigable waters.

On October 28, 1998 President Clinton signed a bill providing new game rules for the treatment and respecting of online copyrighted material. The Digital Millennium Copyright Act, (hereinafter referred to as the *DMCA*),[1]
passed both houses of the one hundred and fifth (105[th]) Congress earlier in the month.[2]

The DMCA adds two (2) new chapters to Title 17 as it strengthens international law worldwide and protects domestic technology.
President Clinton was please with the measure.[3]

The one hundred and fifty (150)-page document divides into five (5) titles in *Fig. 1* below:

Fig.1: THE DMCA

Note: Except for Title I (Treaty), each the following are effective upon enactment:

Title I: Implementation of two (2) treaties dealing with digital issues, copyright protection and management systems.

Title II: Limitation of Online infringement liability for ISPs (Internet Service Providers) (reducing legal uncertainties regarding such items as digital networks, strengthening anti-online piracy, outlining copyright owners' notification procedures, defining university liability, and creating a "safe harbor" for ISPs in four (4) situational activities):

(1) Conduits (provision of materials transmission, routing and connections)

(2) System Caching (temporary or intermediate materials storage)

(3) User Storage (materials)

(4) Information Locators (linkage provision)

Note: 1 and 2: transmission must be initiated by a third party.
3 and 4: requires the ISP to be without knowledge or having reason to know of any infringement, to obtain no direct financial benefit and to not change the materials.

Title III: "The Computer Maintenance Competition Assurance Act" (formerly H.R. 72) (creation of an exception for temporary computer program reproduction in maintenance/repair).

Title IV: "Miscellaneous Provisions" (distance education, exemption for libraries/archives, ephemeral (momentary) recordings).

Title V: "The Vessel Hull Design Protection Act" (formerly H.R. 2696) (creation of new protections for boat hull designs, effective for two (2) years only).[4]

Oddly enough Congress handed down the measure around Columbus Day. It would seem Americans were in store for more than celebrating the discovery of the country. Although technically the Senate still must ratify international pacts before governments of the world give credence to the measure, the law does prepare for the ratification and execution of two (2) treaties regarding *WIPO*, The World Intellectual Property Organization. In December 1996 over one hundred and fifty (150) countries agreed on WIPO at a conference on digital information and copyrights in Geneva. The first treaty clears up digital authors' rights. The second pact focuses upon the Internet and sound recordings. Thirty (30) nations must ratify the agreement for it to be effective globally.[5]

Internet service providers, software industry groups, music/movie companies and the like herald the DMCA. Attorney Jonathan Band, a partner in the Washington, D.C. office of San Francisco's Morrison & Forester, L.L.P, practices copyright law. He states:

> The Digital Millennium Copyright Act accomplishes four things... *First*, it implements the World Intellectual Property Organization treaties, thus harmonizing U.S. copyright law with international law. *Second*, the DMCA establishes "safe harbors" for online

service providers who unknowingly transmit copyrighted works. *Third*, the act permits the copying of software during computer maintenance. *Finally*, the DMCA facilitates Internet broadcasting.[6]

However, members of the academic and research communities express mixed feelings about the measure. Some claim the DMCA would hinder concepts of fair use and other acceptable means of validly utilizing copyrighted materials. Most library organizations opposed the measure citing it does not contain many desired provisions. Specifically, according to Professor Bob Oakley, Library Director of the Georgetown University Law Center, H.R. 2281 will be a hindrance to reading, browsing, classroom teaching and applying of fair use standards:

> HR 2281, as drafted, would grant copyright owners a new and unrestricted exclusive right to control access to information in digital works which could negate one of the most basic principles...the ability to gain access information in published or publicly available works...[7]

Many groups voiced support and opposition for the bill.[8] The Digital Future Coalition, a forty-two (42) member organization comprised of non-profit and for-profit entities interested in intellectual property law in the digital era, opines:

> In the final version of the DMCA, Congress recognized the importance of ensuring balance in the treaty implementing legislation. The DMCA safeguards such crucial activities as computer security testing, reverse engineering to achieve interoperability, the protection of personal privacy, parental supervision of minors on the Internet and the preservation of materials by libraries and archives. It also assures the availability of the next generation of consumer electronics and computer products. In addition, it provides a mechanism to assure the continued vitality of the fair use privilege enjoyed by teachers, students, library patrons and all other information users. These provisions represent a dramatic departure from earlier drafts of the legislation....[10]

Another bill, *The Digital Era Copyright Enhancement Act,* H.R. 3048, is still awaiting approval. The measure included an increase for the preservation of author's rights similar to the provisions in the Berne Convention for the Protection of Literary and Artistic Works. In March 1989 the United States joined the Convention that produced a multinational treaty.[11]

H.R. 3048 amends the first sentence of section 107 of The Copyright Act by adding "analog or digital" in applying fair use to all transmissions.[12] In actual comparison, H.R. 3048 includes many safeguards lacking in H.R. 2281. Among them include legal protections with allowances for the creation of incidental copies, fostering of distance learning[13] protecting of consumers against so-called shrink wrap licenses, negating of ephemeral copyright liability (i.e. making copies incidentally in relation to computer operation), preserving of microfiche technologies, exempting library/archive uses (allowing for the making of temporary computer program copies and utilizing a "knowledge" test as the basis for civil liability; note that criminal liability is not available at this level)[14], and, most importantly for many, the preserving of fair use doctrinal principles.[15] Indeed the two bills have been very much compared and contested of late.[16]

H.R. 3048 indeed expands the fair use doctrine toward notions that library, teaching and research purposes fall into acceptable practices in relation to technological advances. Penalties apply against infringers rather than those on the fringe that may wish to legally and ethically utilize materials.[17]

According to the Software Publishers Association, copyright piracy costs over eighteen (18) billion dollars worldwide.[18] Regarding penalties and liabilities, in general, the DMCA's Sections 1203 and 1204 imposes updated standards and gives guidance for works on the Net especially regarding criminality. Plaintiffs recovering successfully for wrongdoing have the choice of illegally obtained profits, statutory damages or injunctive relief. In a year and a half, it will be unlawful to create or sell any technology used to break copyright protection devices. It also will be illegal to commit acts of circumvention as each will carry statutory damages of twenty-five hundred dollars ($2500.00).[19] And, in a limited manner, willful and purposeful defendants could face serious criminal penalties of several hundred thousand for each violation.[20]

The DMCA contains many criminal impositions for conduct unrelated to infringement. For example section 104 provides for violations regarding circumvention of copyright protection systems in section 1201 or integrity of copyright management in 1202. Anyone who violates either section for "purposes of commercial advantage or private financial gain" faces up to five hundred thousand (500,000) dollars or imprisonment of up to five (5) years, or both for the first (1st) offense. The penalty is up to one million (1,000,000) dollars and up to ten (10) years, or both, for subsequent offenses.[21] DMCA sections 1204 a & b. Courts will have the power to award triple damages against repeat offenders. A five (5) year statute of limitations applies here.[22] H.R. 3048, on the other hand, applies civil relief rather than criminal punishment.

And, H.R. 3048 provides that "no person, for the purpose of facilitating or engaging in an act of infringement, shall engage in conduct so as knowingly to remove, deactivate or otherwise circumvent the application or operation of any effective technological measure used by a copyright owner to preclude or limit reproduction of a work or a portion thereof."[23] The DMCA makes it illegal to "manufacture, import, offer to the public, provide or otherwise traffic in any technology, product, service, device, component or part thereof " that may be used to circumvent a technological protection measure.[24] The law affords protection toward encryption research, security testing and related matters. And devices as to safeguard against child pornography on the Internet were given exemption in this respect.

Conclusion

There are several bills such as H.R. 3048 still on Congress's plate. The DMCA is a massive complexity of rules and regulations. If we are to advance in the digital age, we must have a compromise between right and rule. It will be a test of time as to whether or not the Clinton administration's efforts will be a cure or a curse for the new millenium in copyright. The only way to examine the DMCA's validity is by trial and error. Unfortunately we will be cursed with many of each.

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* Dr. Robert N. Diotalevi is Director of Legal Studies and Associate Professor at The College of West Virginia. He has been a lawyer for thirteen years. He possesses four (4) degrees and has been internationally published.

1. H.R. 2281 in the House of Representatives, and S. 2037 in the Senate (S. 1121, abandoned with the passage of this legislation).
2. The complete text is found at <http://thomas.loc.gov/cgi-bin/query/z?c105:H.R.2281>; *see, generally,* <http://www.loc.gov/copright>, <ftp://ftp.loc.gov/pub/thomas /cp105/hr796.txt>, and <ftp://ftp.aimnet.com/pub/users/carroll/law.copyright/h2881enr.txt>. For a comprehensive analysis, *see The Digital Millennium Copyright Act,* by Mark Radcliffe at <http://www.gcwf.com/articles/interest/interest_11.html>.
3. *Statement by the President*, Office of the President's Press Secretary, The White House, October 12,1998, at <ftp://ftp.aimnet.com/pub/users/carroll/law/copyright/h2281- res.txt>.
4. *See, e.g.*, <http://thomas.loc.gov/cgi-bin/query/z?c105:H.R.2281.enr> and <http://abanet.org/intelprop/hr2282.html>. For a better understanding, *see* The Software Publishers Association, <http://www.spa.org/govmnt/iprt/dmcasumdraft.htm>.
5. *See, e.g., New Global Treaties Protect Copyrights Online,* by Ralph Oman, Law Journal Extra, at <http://ljx.com/copyright/p4global.htm>.
6. *Lawyers and Technology: The Sound of One Computer Copy,* by Wendy Liebowitz, Law Journal Extra, (citing The National Law Journal), November 2, 1998, p. A16 (*emphasis added*), at <http://www.ljx. com/news/dime.htm>.
7. *American Library Association News and Views*, June 10, 1998 at <http://www.ala.org/news/copyright.html>.
8. Association of Research Libraries, Washington, DC at <http://arl.cni.org> (*Press release*, Sept. 29,1998).
9. Digital Future Coalition, October 16,1998, at <http://ari.net/dfc/issues/wipo/pr101698/pr101698.html>.
10. The bill is located at <http://lcweb.loc.gov/copyright/penleg.html>; <http://thomas.loc.gov/cgi-bin/query/D?c105:1/temp/~c105OrOe2w:ell1128> and <http://www.panix.com/~jesse/pending_legislation.html treaty>.
11. *See* Berne Convention Implementation Act of 1988, Pub. L. No. 100-568, 102 Stat. 2853 (codified in 17 U.S.C.A. sec.101 (1996)).
12. H.R. 3048 sec.2.
13. *Id* at sec. 5
14. *Id.* at sec. 3
15. *Id.* at sec.4.
16. For detailed, side-by-side comparisons of the two bills, *see* <http://www.ari.net/dfc/legislat/wipo.htm> and The Digital Future Coalition at <http://www.dfc.org/issues/wipo/head2hd/head2hd.html>; *see also* <http://weber.u.washington. edu/~daryn/copyright/legislation.html> as well as The American Library Association at <http://ala.org/washoff/boucher.html>.
17. *See, e.g.,* the Home Recording Rights Coalition's views at <http://hrcc.org/111497pr.html>.
18. <http://www.spa.org/govmnt/iprt/wipotalk.htm>.
19. *See, e.g., Digital copyright bill becomes law*, by Courtney Macavinta, October 28, 1998, at CNET NEWS.com, <http://www.news.com/News/Item/0,4,28060,00.html?owv> .
20. *Id.*
21. DMCA sections 1204 a & b.
22. *Id* at section 1204 (c). *See, e.g.*, <http://spa.org/govmnt/iprt/wipotalk.htm>.
23. H.R. 3048 at <http://thomas.loc.gov/cgi-bin/query/c?105:1:.OrOe2w:e1128>.
24. DMCA, section 1201(b).

Computer-Mediated Learning, Synchronicity and the Metaphysics of Presence

Ray Land, Centre for Teaching, Learning and Assessment, University of Edinburgh, Scotland, ray.land@ed.ac.uk

Siân Bayne, Educational Development Unit, Napier University, Scotland, s.bayne@napier.ac.uk

Abstract: This paper addresses the question of the noticed resistance of many learners, and indeed teachers, to the use of computer-mediated discussion in the support and delivery of learning programmes, and their preference for face-to-face modes of teaching. It applies some of the insights gained from post-structuralist theories of language in order to approach a fuller understanding of this preference, and concludes that a fundamental re-thinking of our understanding of the educational experience, and its cultural context, is necessary if we are fully to engage with the opportunities presented by computer-mediated approaches to learning.

Introduction

This paper originates in attempts to explain, at a practical level, the perceived disinclination of learners to participate in computer-mediated conferencing (CMC) in contrast to traditional face-to-face teaching. This apparent privileging by learners of face-to-face environments in our own experience of managing CMC programmes, in addition to similar learner resistance reported by other providers (Akers 1997; Finkelstein & Dryden 1998; Grint 1989; Von Prümmer 1995) led us to seek theoretical explanations of such preference, the better to be able to deal with related pedagogical considerations. Earlier explanatory models have attempted to account for face-to-face preference through, for example, the idea, derived from social presence theory, of reduced social cues (Gundewara 1994), or of the ephemeral nature of 'orality' (Zuboff 1988). In psychology, more determinist social learning approaches, derived from the psychological Theory of Mind (TOM), suggest that we are hardwired for social interaction, with the mind expecting to find intersubjectivity. Most of these studies, it seems to us, lack explanatory power in relation to CMC and pedagogical implications for the management and practice of learning in CMC environments. This is not surprising, since such perspectives reside within a realist/humanist tradition which by definition, as will be explained below, always cedes precedence to face-to-face approaches to teaching and learning.

There is need for a theorised account of CMC from an alternative perspective. Given that CMC is essentially a *text*-based environment, one in which learning is mediated entirely through the processes of reading and writing, a much more compelling approach may be derived from the insights gained from post-structuralist theories of language, in particular the work of the French philosopher, Jacques Derrida. Our claim is that the privileging of face-to-face learning over CMC derives, from the privileging of speech over writing that Derrida has forcefully identified as the most central hierarchical opposition in the history of Western metaphysics. The privileging of speech, moreover, is associated with the notion of personal *presence*. As Feenberg has noted:

> In our culture the face-to-face encounter is the ideal paradigm of the meeting of minds. Communication seems most complete and successful where the person is physically present 'in' the message. This physical presence is supposed to be the guarantor of authenticity: you can look your interlocutor in the eye and search for tacit signs of truthfulness or falsehood, where context and tone permit a subtler interpretation of the spoken word. (Feenberg 1989)

Such a position appears so commonsensical within traditional western culture that it comes as something of a shock to find Derrida describing speech as another form of 'writing' and denying its status as a more authentic source of 'truth'. This paper will argue that resistance to the loss of face-to-face teaching can be seen as attributable to a generally unexpressed awareness that CMC undermines the position of speech over writing, and in doing so also undermines the entire realist and humanist perspective from which, in Western culture, we construct ideas of truth, presence and subjectivity.

These are indeed large and no doubt provocative claims. Hence priority is assigned below to a careful exposition of the philosophical basis of our argument. The final purpose of the paper, however, is to return to the pedagogical considerations from where the discussion originated, and to describe what in our view are crucial implications for the roles of tutor, moderator and learner in CMC environments, and even for the nature of the institutions in which such programmes operate.

Language and the dispersed nature of meaning

To approach the issue of why CMC participants seem uneasy with the loss of face-to-face teaching it is first necessary to 'problematise' the nature of language. The seeming nature of language as a transparent lens through which we perceive 'reality' rather than as the medium through which realities are constructed is part of a process operating within CMC which we are here concerned to challenge. It is easy to forget that the computer-mediated learning environment is essentially a collection of written texts – a 'written world', to use Feenberg's phrase. Though we often refer to participants in CMC environments as 'speaking', 'chatting', 'talking', having a 'voice' and engaging in 'conversation' and 'discussion', and refer to them collectively as an 'audience' that 'hears', such metaphors are themselves examples of the privileging of speech over writing mentioned earlier.

The full impact of post-structuralist thought, and its relevance to computer-mediated learning, can be approached through the work of the structuralist linguistic theoretician Ferdinand de Saussure. Saussure views language as a system of signs; each sign is composed of a signifier (a word, written or spoken) and a signified (the concept or meaning) (Saussure 1974). The relation between the signifier and the signified is arbitrary. There is no intrinsic or given connection, for example, between the word 'mouse' and the small mammal. If there were, the word for 'mouse' would be the same in every language, and 'mouse' would not also mean 'a small device which controls the cursor on a PC screen'. What is more, the meaning of a sign is not complete in itself – it has meaning only because of its difference from other signs. For example, 'mouse' only means 'mouse' because it is *not* 'house', 'mousse' or 'louse'. Despite the fact that language appears transparent (the connection between the word 'mouse' and the concept of a mouse seems clear and unproblematic to the user of the language) the construction of meaning is actually complex; language becomes a system of differences with no positive terms, meaning can only be a product of social and historical convention.

Further, language does not provide us with a set of terms or labels which we use to name entities which already exist independently in the world. Rather language precedes the existence of these entities, enabling us to make the world intelligible by differentiating between concepts in a way which is particular to our own cultural context. For example, in Welsh the colour 'glas' ('blue') includes elements which in English would be identified as 'green' or 'grey'. There is no objective experience of the colour 'blue' – like language itself, colour terms form a system of differences which seem 'natural' but are in fact enabled or constructed by the language itself (Belsey 1980). The language forms our view of the world, and therefore forms us as conscious, social entities.

Post-structuralist theorists such as Derrida take these ideas further. They highlight what is implicit in Saussure's theory, which is that, if every sign gets its meaning from the fact that it is *not* all other signs, every sign consists only of an infinite web of differences. In other words, because the meaning of a sign consists of what the sign is *not*, meaning is never fully present and complete in the sign – rather it is dispersed among all the other signs in existence. Meaning cannot be nailed down, it is inherently unstable, 'never fully present in any one sign alone, but rather a kind of constant flickering of presence and absence together' (Eagleton 1983).

The implications of these ideas are serious for traditional systems of thought. Language loses its status as a handy tool which enables us to speak about and reflect on 'reality'. To use language at all involves us in a dispersal of meaning throughout the infinity of the system of signs. And since we ourselves *are* in a sense our language (it is the means through which our world and our place within it are constructed), the status of our identities (or selves) as stable and unified is also under question.

Logocentrism and the metaphysics of presence

Derrida, whose brand of post-structuralist philosophy is termed 'deconstruction', sees the history of Western philosophy as being based in 'logocentrism' – the belief in some centre, some ultimate Word ('*logos*'), truth or reality which is not subject to this dispersal, which anchors all thought, language and experience, and provides an ultimate meaning which cannot be questioned. Notions of God, Truth, the Self, Nature and so on can all be seen as having their roots in logocentrism which, for Derrida, is closely bound up with what he calls the 'metaphysics of presence'.

> Presence appears as the things we see; as the immediacy of the ideas and representations we have; as substance, essence and existence; as the temporal present, the now of the moment, as the self-presence of consciousness, of subjectivity, as one's own inner experiences and ideas etc... Presence constitutes the essential truth of reality; hidden from our sight possibly, but present in its entirety to some divine mind. (ibid)

Post-structuralist thought stresses that any such transcendental meaning is fictional, in the sense of being constructed. There is no concept which exists outside systems of thought and language; there is no concept which is not involved in the infinite play of meaning. In order to function socially we do make temporary determinations of meaning but meaning itself is never determinate (Derrida 1978).

Textuality

Ideas about the nature of text itself are radically affected by the ideas of the post-structuralists. Texts are no longer seen as closed, stable entities, holding within them definite meanings which the reader is required to decipher. Rather, they become a temporary arena for the endless play of signifiers – they cannot be tied down to any one meaning, but remain open and pluralistic, subject to multiple interpretation. All texts are woven out of other texts in that every element of them refers to other writings which surround, precede or follow, much as the sign itself is composed of traces of every other sign. This is broadly referred to as 'inter-textuality'.

The relevance of the post-structuralist vision of language to the study of electronic texts such as those found in CMC – and, increasingly, in web-interfaced versions where CMC texts become increasingly hypertextual and linked – becomes clear. Eagleton's account of the play of language from a post-structural perspective is powerfully suggestive of the kind of interplay found in CMC discussion.

> Instead of being a well-defined, clearly demarcated structure containing symmetrical units of signifiers and signifieds, [language] now begins to look much more like a sprawling limitless web where there is a constant interchange and circulation of elements, where none of the elements is absolutely definable and where everything is caught up and traced through by everything else. (Eagleton 1983)

What is more, the traditional hierarchical relationship between texts is undermined. Where traditionally a so-called central or 'primary' text takes a central position, provides a focus for discussion and interpretation in the form of marginal or 'secondary' texts, deconstructionists would claim not only that the central can become marginal (and vice versa) but that the very difference between the two is brought into question. Since both are subject to infinite play of meaning and interpretation, we cannot say where one ends and the other begins. When we apply this insight to the realm of CMC intertextual 'discussion' we can immediately conceive of a questioning of traditional assumptions relating to which 'voice' or text is authoritative and takes precedence over the others. A levelling effect in the relationship between tutor and student can perhaps be seen as one inevitable consequence of the move from the face-to-face interchange to one taking place in a CMC environment.

Speech, synchronicity and presence in CMC

In addition to its essentially textual nature, CMC is characterised in most instances of its use by its other distinctive feature – *asynchronicity*. It is not difficult to see how asynchronicity can become identified in the minds of learners with inauthenticity.

> Traditionally speech is favoured as the concept which best represents the semantic relationship of language to thought in virtue of its own essential and immediate causal proximity both to the thoughts which give it its meaning and to the thinker having those thoughts, expressing these meanings... (Parker 1997)

Speech appears to emanate directly from its 'author'– the presence of the author is self-evidently required for speech. In this regard *presence*, in the sense of physical presence, requires synchronicity. If a logocentric perspective is maintained then *a*synchronous activity undermines such truth at a glance, and the house of cards collapses. And of course *writing* is by definition asynchronous in nature, traditionally seen as being a step removed from the 'author' in a way that speech is not. Hence text-based conferencing comes to be seen as 'inauthentic'.

CMC, of course, is heavily and obviously mediated both through written text and computer technology. Face-to-face, in comparison, *appears* deceptively to approximate to the ideal speech situation. It is of course no such thing and is as mediated, though by no means as self-evidently, through linguistic signs and signifiers that are as independent of the self and *as dependent on a linguistic system and interpretation* as any written text.

Bivalence, realism, and deconstruction

As Culler has pointed out, Derrida's claim is twofold:

> First the moment of speech, or rather the moment of one's own speech, where signifier and signified seem simultaneously given, where inside and outside, material and spiritual seem fused, serves as a point of reference in relation to which all these essential distinctions can be posited. Second, this reference to the moment of one's own speech enables one to treat the resulting distinctions as hierarchical oppositions, in which one term belongs to presence and the logos and the other denotes a fall from presence. To tamper with the privilege of speech would be to threaten the entire edifice. (Culler 1983)

Culler draws attention here to a final key concept in our argument, what he terms 'hierarchical oppositions', derived from Derrida's notion of *bivalence*. In Western thought and reason, Derrida claims, bivalence has consistently served to sustain a central conceptual hierarchy of terms. Western philosophy has historically operated through a network of conceptual hierarchies, dependent upon the function of binary oppositions, in which one pole of the binary opposition is always privileged over the other.

> In a traditional philosophical opposition we have not a peaceful co-existence of facing terms but a violent hierarchy. One of the terms dominates the other...occupies the commanding position. To deconstruct the opposition is above all, at a particular moment, to reverse the hierarchy. (Derrida 1981)

As Culler emphasized, the dominant term is always that which 'belongs to presence and the logos'. Such binary oppositions underpin traditional Western ideologies and value structures such as realism in philosophy, humanism in the arts and positivism in science. Examples of such oppositions would be: mind/body, male/female, white/black, self/other, nature/culture, presence/absence, theory/practice and so on. In each of these cases, the latter term is seen as a deviation from or perversion of the former. As Parker suggests:

> The hierarchical ordering is a symptom of the way in which a text *assumes the normality* of one pole of the opposition and sees the other as simply a negative, a distortion, a perversion or a parasite of the original concept. Texts, consequently cannot be viewed as possessing a structure which is natural, value-neutral, uniform. Instead, the textual structure is an economy in which the currency of a concept is determined by its place among other concepts within a system of value exchange and difference. (Parker 1997)

Implications for teaching and learning using CMC

If we consider the discourse of education in textual terms it is interesting to speculate what might be the binary oppositions that would emerge and what normality would be 'assumed', in Parker's phrase. A tentative conceptual hierarchy might include the following:

- teaching/learning
- tutor/student
- research/teaching
- education/training
- face-to-face/distance-mediated
- synchronicity/asynchronicity
- speech/writing
- author/reader
- cognitive/affective
- individual/collective
- disciplinar(it)y/interdisciplinarity
- singularity/multiplicity
- local/global
- institutional/personal
- rationality/irrationality
- competition/collaboration
- unity/fragmentation

Again, it is reasonable to assume that dominance and presence reside in the former terms. It is not surprising, for example, to find that in quantitative research into face-to-face tutorial group interaction, the amount of teacher talk massively outweighs that of student talk (Foster 1981).

We can only conclude that a dispensation such as that above is not only the product of an existing realist-positivist academic culture but also serves to sustain such a culture. Traditional academic institutions that maintain such hierarchical bivalences as teaching/learning, tutor/student, author/reader will *always* favour face-to-face modes of learning, not only because such a mode privileges the role of teacher over taught and institution over person but because 'realism is situated as having a phonocentric bias which is symptomatic of a deeper commitment: logocentrism or the metaphysics of presence.' (Parker 1997)

George Landow (1997) has commented on the way in which CMC and other new learning technologies pose a challenge to traditions which, as we have attempted to show, have their basis in logocentrism and the metaphysics of presence, through enabling and indeed requiring ways of working which are traditionally resisted in the academic context. Studying in the electronic arena encourages collaborative rather than competitive approaches, the violation of disciplinary boundaries and the re-thinking of the tutor/student relationship.

Just as in the literary domain Roland Barthes famously announced in 1967 the Death of the Author, it may well be that reports of the Death of the Tutor have not yet been sufficiently exaggerated as the new medium replaces this hierarchical role with the more democratic one of moderator/facilitator who acts as co-learner. But the online moderator needs to acknowledge that identities created online may well differ from face-to-face identities, whilst remaining equally valid. Turkle (1995) provides lucid insights into the creativity, energy, irony and playfulness of online identity and behaviour.

The moderator role in CMC assumes critical importance in this respect. As online writing allows for the possibility of much greater freedom and elaboration of identity, the unified self assumed within face-to-face encounters may fragment into many facets or faces in online environments. The loss of one face may permit the emergence of several. As Baltz has pointed out:

> instead of identity having the status of an initial given (with which the communication usually begins), it becomes a stake, a product of the communication. (Baltz 1984:185)

To have a centre is important but, as Derrida has commented in respect of the notion of 'de-centering', the centre is a *function*, not a being. In the same way, online moderation is a function that does not necessarily have to be dominated by one individual, traditionally the tutor.

At a practical level of operation CMC offers an unprecedented opportunity for the encouragement of the active, empowered reader/learner. CMC and related hypertextual technologies resist the grip of logocentrism in a new way, and provide opportunities for learners (and 'tutors') to work explicitly with ideas of plurality and multiplicity that have been historically denied, and which could well be emancipatory in their effects. In order to fully explore these effects we need, however, to change our perspective, understanding and expectations of educational experience and purpose. If we do not, face-to-face modes will always remain dominant – working within the existing realist paradigm will never lead to a questioning of its own (occluded) assumptions.

But the alternative will be challenging, risky and difficult. The effects of post-structuralist thought are unsettling. It does seem to threaten, in Culler's phrase, 'the entire edifice', much in the manner perhaps in which Darwinism threatened the edifice of prevailing Victorian thought and values. And unsettling the fundamental values of our students – and colleagues – is not something to be countenanced lightly, however educationally well intentioned. We do not underestimate he potentially negative aspects of online interaction, nor do we ignore the capacity of virtual environments to be colonised in the interests of managerialist imperatives. Our intention is to lay emphasis on the emancipatory effects of CMC.

The strategy of a deconstructivist approach is to undertake a reversal of hierarchical opposition, not to replace one generalising conceptual hierarchy with another, but to subvert the original logocentric stance by bringing various realities into play. CMC is ideally suited for this purpose. In similar fashion it has been our intention in this paper to provoke debate through challenging the realist perspective by drawing it into play with alternatives. We hope that colleagues will enter into the spirit of plurality we wish to foster by reciprocating the challenge.

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Designing Effective Learning Environments for Distance Education: Integrating Technologies to Promote Learner Ownership and Collaborative Problem Solving

Dennis Knapczyk: Special Education, Indiana University, U.S.A., knapczyk@indiana.edu

Haejin Chung: Special Education, Indiana University, U.S.A., hachung@indiana.edu

Abstracts: Rapidly developing technologies do not themselves create more interactive distance education learning environments. Investigations of teaching practices coupled with a review of the literature have led us to establish three major aims to guide in the design of coursework and the selection of distance education technologies. These aims are to promote learner ownership, to foster situated learning, and to encourage collaborative problem solving. This article describes the different types of distance education technologies we use and how these technologies are integrated to meet these aims.

The Collaborative Teacher Education Program (CTEP) at Indiana University was created twelve years ago to address the critical shortage of special education teachers in Indiana (Knapczyk & Rodes 1995; Knapczyk, Rodes, & Brush 1994). The lack of fully certified teachers in many communities is compounded by the difficulty teachers have obtaining university training. By offering coursework via distance education, CTEP allows in-service teachers to complete the entire 36-credit hour requirement for earning special education licenses in their communities.

Over the years, the communication technologies used in CTEP have advanced from speaker phones and the U.S. Postal Service, to computer-based audiographics and fax machines, to multi-point videoconferencing, web conferencing and e-mail. New technologies and increasing capabilities of interactivity are providing new tools for distance education. However, the advancement of technology alone does not automatically guarantee a more interactive and effective learning environment.

Investigations of teaching practices coupled with a review of the literature associated with teacher education have led us to establish three major aims to guide in the design of coursework and practicum activities and the selection of distance education technologies. These aims are to promote learner ownership, to foster situated learning, and to encourage collaborative problem solving. One challenge that has remained constant from the beginning of CTEP is tailoring the capabilities of new technologies to create an effective learning environment that meets these aims. In the next section we describe the different types of distance education technologies we use and discuss how these technologies are integrated to meet our program aims.

Distance Education Technologies

Audiographics

We began the program using audiographics to support in-class communication with students. Audiographics involves two telecommunications links, one that connects computers via modems and a second link that provides an audioconferencing medium through a normal telephone connection. Although audiographics is usually overlooked in the rush to more up-to-date video options, its low cost and broad delivery capabilities make it still viable for programs that emphasize outreach or low instructor-to-student ratios (Knapczyk & Rodes 1995).

One real advantage we found when using audiographic technology is that the limitations of a non-video format forced us to adopt effective teaching strategies that are often overlooked in campus-based courses. Rather than lecturing over the speakerphone, we learned to encourage the trainees at the remote site to lead discussions, explain key point from the text, and take part in small-group activities that relate to the projects they are conducting in their classrooms. To facilitate this process, we had trainees take turns acting as on-site coordinators, and we contacted them in advance to help them prepare to lead the class. We also found it very important to include specific written guidelines for any class activities and text materials that are closely adapted to the needs of the course, as there is little opportunity for the kind of lecture that takes place in campus-based courses to provide background information.

Two-Way Videoconferencing System

Two years ago we began offering coursework using a large-group videoconferencing system that employs high-speed telephone lines to transmit quality video and audio. Both origination and remote sites have large-screen monitors, speakers, and built-in cameras and microphones. In addition, the sites also have computers, document cameras, and videotape units for displaying graphics, hard copies or videos. This system has allowed us to connect two or more remote groups for our class sessions.

Videoconferencing equipment offers the obvious advantage of trainees and instructors being able to see one another and follow visual cues. Seeing the instructors makes students much more comfortable, and it is much easier to explain issues and spot problems. Even so, we have made a deliberate effort not to lose the insights we gained from our experience with audiographics. We still have many student-centered activities and discussions, and we involve trainees as much as possible in running the class, including operating the video equipment. The importance of using text materials that are functional and closely adapted to the course remains the same with videoconferencing system. Although our trainees can now see us, they are just as likely as students using audiographics to become restless if we do not keep them actively involved in class activities.

Web-Based Conferencing System

Web-based conferencing provides a powerful internet tool for creating a more interactive and less isolated experience for distance learners. We have incorporated a web-based conferencing system into CTEP to encourage interactions among students across training sites to help make them feel more a part of a class group. We are using an asynchronous web-based conferencing system, called Alta Vista Forum. All discussion on the conferencing system is directed toward existing course content and practicum projects: rather than using this opportunity to create extra work for learners, we use it to help improve their understanding and application of the work they do through collaborative learning. We created teams of 4-5 students across sites to encourage closer ties between our remote sites. We have also provided a "chat room" and "teachers' lounge" to give students open forums for socializing with one another and for discussing more personalized issues and concerns.

Support Technologies

Simple technologies such as fax machines and e-mail are among the most reliable and flexible tools we have for communicating with distance learners. Both of these technologies give us continuous access to our trainees and provide for rapid asynchronous communication between university instructors and learners.

Integrated Use of Technologies to Meet Program Aims

Fostering Ownership among Learners

A strong sense of ownership is a critical factor for learners in distance education settings. Learners who are not in close physical proximity to their instructors must often work more independently than learners in traditional settings (Kember 1995). In fact many distance educators attest that independence and a strong sense of ownership are essential predictors of success in distance education learners (Riddle 1994; Wagner & McCombs 1995). But distance education must also cater to the needs of students who may not have such a strong natural inclination to ownership and self-sufficiency. Instructors and instructional designers need to make a deliberate effort to promote and encourage ownership among students, especially for those who may be used to teacher-directed instruction where they make few choices for themselves.

To encourage ownership in CTEP, we emphasize new roles of instructors and learners in the beginning of the semester. We use trainees as student coordinators to oversee such instructional aspects of the class sessions as working out grouping arrangements for activities, assisting with the actual course instruction and duplicating and passing out papers. Further, we structure class sessions so learners act as on-site facilitators to lead discussions and present material from the text rather than having the campus-based instructors do these tasks. Since we have more than one remote sites in a live class, we have the on-site coordinators ask the other site to present ideas and examples instead of us directing the activity in order to promote greater communication across groups. A typical class period involves several small-group work and discussion activities, with instructors acting as consultants more than as presenters. We have found that adult learners bring a wealth of professional skill and experience with them to their classes. Distance education can capitalize on these experiences in a manner that facilitates the mechanics of course delivery, enriching the content and teaching interactions of the class sessions and more closely involving teachers in their professional development.

Promoting Situated Learning

A major criticism of many current pedagogies is that they are too abstract, removed as they are from real world experience (Brown, Collins, & Duguid, 1989). An important concern for educators is the degree to which classroom learning transfers to external situations in which the application of knowledge, skills, and attitudes is appropriate (Oliver & Reeves 1996). The field of teacher education has also shared this similar concern. Many teacher education programs have no effective way of ensuring that students learn to apply course concepts to their actual teaching situations (Cole 1992; Dessent, 1987). Students may enroll in a practicum or student teaching experience after their coursework is complete, and may work in another teacher's classroom rather than a setting of their own.

Distance education can be designed to offer students an opportunity to work on authentic tasks in a real-world setting in which students construct knowledge for themselves. This type of instruction is referred to as *situated learning* (Winn 1993), because the process of constructing new knowledge is situated in meaningful, relevant contexts. To promote situated learning in CTEP, we assign practicum projects that serve as a focus of the trainees' learning experiences. We structure the practica and academic coursework as a single unified instructional activity so teachers practice new methods as we cover them in the classes. They learn to integrate these approaches with their existing routines, combining their new skills with the skills they already have to form increasingly complex and unified teaching practices. At each stage of training, teachers learn how to fully integrate theoretical concepts into teaching practices that match their particular job situations.

We further ensure situated learning by visiting the remote sites so we can obtain firsthand information about the circumstances in which the trainees teach. Meeting with students in person at their work sites helps instructors better understand their practicum situation, which in turn, enables instructors to give detailed and situation-specific guidance and feedback to each trainee. By combining e-mail and fax transmissions with site visitations, we are able to bring a high level of supervision not just to their understanding of course concepts, but to their actual application of these concepts in real-life settings.

Encouraging Collaboration among Teachers and Facilitating School Change

Research in teacher education has shown the value of within-school professional team building and collaboration among teachers (Friend & Cook 1993; Koehler & Baxter 1997). Fullan (1991) argued that school improvement is most surely and thoroughly achieved when teachers engage in "frequent, continuous and increasingly concrete and precise talk about teaching practice" (p. 78) with other teachers. Today each special education teacher must operate as part of a team in many aspects of his or her role (Polloway & Patton 1997). However, traditional models of teacher preparation usually do not include strategies for promoting collaborative problem solving with other adults.

Because CTEP is field-based, we attract teachers who work in the same schools or in the same school district. We take advantage of our trainees' shared circumstances by incorporating collaborative team building techniques into the very structure of our coursework. In CTEP collaborative techniques serve both as means to encourage interaction among learners in a live class and as ends to help them collaborate with other adults at their job sites. As stated by Johnson and Johnson (1987) and Slavin (1990), when instructional delivery systems are structured to foster cooperative learning, learners benefit both instructionally and socially.

The technologies we use help us structure a variety of in-class and out-of-class activities in which teachers describe their teaching experiences, brainstorm solutions to real-life problem situations, and help one another apply and adapt the course concepts to their job circumstances. For example, as out-of-class activities we are using web-based conferencing to promote collaborative learning. While in-class groups are formed according to shared interests or circumstances within the same remote site, groups for web activities are formed across multiple sites so teachers can benefit from an even broader and more diverse range of perspectives. To structure these discussions, we require students to participate in three kinds of interaction: posting examples from their projects, discussing course content, and consulting with peer teams to generate a fuller range of ideas for their field-based projects. In each of these formats, the asynchronous environment gives trainees the opportunity to review other teachers' work, evaluate their comments and develop their own understanding of course concepts and procedures.

We have found that eliciting a quality discussion on the web requires careful preparation and being cautious about when to ask learners to post examples of their work. Instructors must decide whether to post models of assignments and ask trainees to give only appropriate examples, or to have all learners post work-in-progress and then attach instructors' comments so learners do not accidentally consult nonexamples. Instructors also need to make sure that discussion topics are content-based and that the outcomes of the activities are reasonably beneficial to all trainees; the topics should not be too abstract, general, or contrived. In addition, the way learners are supposed to reply to each other also must be clearly specified so trainees do not just post short "I-agree-with-you" type comments to fulfill the requirement. Furthermore, instructors should also be careful that learners do not go too much ahead of the course schedule and suggest ideas solely based on their own teaching habits, which might not be consistent with the goals of the course. Finally, like any other learning activity, instructors must monitor and evaluate web activities and provide feedback to the class, if not to each learner.

Conclusion

Rapidly developing technologies do not themselves create more interactive distance education learning environments. One challenge that has remained constant from the beginning of our program is adapting new technologies to match our instructional aims. Distance education has traditionally been more successful with students who exhibit a strong sense of ownership: students who are independent and highly motivated. In CTEP we have attempted to structure course and practicum activities to build this type of ownership in students with all types of learning characteristics. We have also encouraged a level of collaboration in which trainees can take advantage of the wealth of experiences each brings with them into the program. In CTEP collaborative techniques serve both as means to encourage interaction among learners in a live class and as ends to help them become more effective teachers at their job sites.

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A Web-based study of students' attitudes towards the Web

Thao Lê
School of Education
University of Tasmania
Australia
T.Le@utas.edu.au

Quynh Lê
University Department of Rural Health, Tasmania
University of Tasmania
Australia
Quynh.Le@utas.edu.au

Abstract: While experts in educational multimedia generally welcome the Web in education, it is important to take into account the views of learners about the role of the Web in teaching and learning, as they are the primary participants in the Web-based educational experience. This paper discusses a Web-based study on learners' views of the Web. The discussion starts with an examination of the emergence of the Web in education and some key features, which represent a shift to a new educational paradigm. However, what Web specialists' value may not be necessarily accepted by learners. Therefore, it is important to examine learners' view in relation to the Web impact. The second part of the paper deals with a study using a Web-based research approach to investigate the attitudes of university students towards the role of the Web in teaching and learning.

Introduction

The emergence of the Web in education has generated a great deal of interest among theorists as well practitioners. For many Web enthusiasts, the Web has challenged the traditional strict curriculum control approach in which learning is at the mercy of teaching. The Web can be used to foster three significant aspects of learning: independent learning, creative learning, and flexible learning. While it is generally accepted that the Web is an important facility for teaching and learning in a modern world, its role in education can be questioned from different fronts. From the critical theory perspective, for instance, the Web-based teaching may easily commit the same ideological 'crime' as other conventional teaching methods: cultural insensitivity, misempowerment, mistreatment of learners as virtual beings.

It is important to take into account the views of learners about the role of the Web in teaching and learning, as they are the primary participants in the Web-based educational experience. This paper discusses a qualitative study, which investigated how learners valued the Web educationally. The paper will start with an examination of the emergence of the Web in education and some key features, which represent a shift of educational paradigm. The follow-up discussion will present a study using a Web-based research approach to investigate the attitudes of students towards the role of the Internet, mainly the Web, in teaching and learning.

The Emergence of Web-based Teaching

The Web has become a world phenomenon. It has permeated many aspects of the modern world, particularly in business and education. The 10th World Conference on Educational Multimedia and Hypermedia held in Freiburg, Germany in June 1998 attracted over 1000 participants from 46 countries, with a total of 485 papers and 130 posters. This is one of many Web-related seminars and conferences around the world in the same year. The cliché 'www dot' has appeared constantly in many TV ads and public announcements. The Web has created its own culture with its own language and its own people with their discourse community. In the educational context, the Web has provided a new platform, which stimulates a new spirit and practice of teaching and learning. In the context of multimedia, as Fisher (1994) points out, the real appeal is in more than the ability to merge video and computer technology in a single application, although that has provided the excitement that drives multimedia research and product development. The hypertext aspect of multimedia provides the underlying informational motive force that stands to revolutionise the presentation of information. Hyperlinks, automatic searches, and the ability to connect pieces of information in a network or web of knowledge offer new capabilities to information developers using multimedia, but the added complexity offers new challenges as well (Fisher 1994).

The Web with a New Educational Paradigm

Roberts (1997) describes a paradigm shift caused by the introduction of the Internet in education. He says:

> In the field of education, it is argued that we are undergoing a 'paradigm shift'; the rejection of one set of values and ideas about education and the adoption of a new set with regards to what constitute effective pedagogy. This paradigm shift is said to be occurring world-wide but faster in some parts than others depending on the availability of resources, existing infrastructure and the stage of development reached.
>
> (Roberts, 1997, p.380)

The emergence of the Web in education can be viewed in three phases. Broadly speaking, a teacher or learner who becomes a member of a Web discourse community tends to go through three stages, which can be described in terms of the relationship between the Web and learning: learning about the Web, learning the Web and learning via the Web.

- *Learning about the Web*: This is the initial stage of getting to know what the Web is all about. A decade ago, the World Wide Web was not in existence. A few years later, the Web metaphorically became a street directory for commuters on the superhighway embedded in a complex network of electronic interaction like a spider web.
- *Learning the Web:* The Web is not a terrifying land where novices are tortured. It can be used and enjoyed by computer experts as well as lay people. Web- oriented devices are produced constantly to ensure user-friendliness. Learning the Web can range from learning complex tasks with the use of Java technology to create powerful 'web-ware' to learning how to navigate on the superhighway simply by 'pointing and clicking'. In other words, the Web can be a great challenge for Web-based software developers as well as a relaxing tool for Internet travellers.
- *Learning via the Web:* This is the most crucial stage of Web orientation. The Web provides a special key to education: Teaching and learning can take place in a virtual reality. The traditional face-to-face teaching in a classroom is no longer the only way of teaching. Learners are no longer confined to their seats in front of a teacher. They do not have to wait for the time when a library is open to search for information.

The Web has become a challenge to traditional face-to-face teaching. Its emergence in educational theory and practice has been marked by the following Web phenomena: Web-based learner, virtual class, and courseware.

Web-based Learners

In the current context of teaching and learning, lecture in its tradition sense does not meet the demand of learners as lecture can only function in a very limited context. Lectures are traditionally the kernel of university education. This traditional form implies that everybody who wants to attend has to be in the lecture room at lecture time. If the target group for the lecture is distributed over a larger area, attending lecture can often be time-consuming or even impossible (Anderl & Vogel 1998). In a narrow traditional approach to teaching, students are normally treated as passive learners. Their minds are treated as empty vessels to be filled with knowledge. Teachers are knowledge transmitters and are therefore the primary resource for learning. Learners are taught how to learn. This notion of learning has been challenged on the grounds that learning is not to receive knowledge but to make sense of knowledge and to promote in a learner an independent mind, which can inform, reflect, and even challenge the conventional knowledge and wisdom. The Web is claimed to be one of the most powerful tools for providing teachers and learners with necessary conditions for independent and interactive learning. It provides an educational discourse in which learners can interact widely with other members of a learning community at the same time learners are in control of their own learning. Their interaction for learning can be immediate, prompt, widely shared and resource-supportive and this may not be possible in a traditional mode of teaching in which teachers and students are heavily constrained by the physical condition of a classroom.

Virtual Class

The concept 'virtual reality' has generated generic concepts such as virtual course, virtual university, virtual conference etc., which have become realities in current academic activities around the world. Since the world has become a global village in which villagers communicate quite conveniently via the Internet, education is no longer confined to a group of local students coming from a community in which a university or school is located. Universities have offered courses for students of diversified geographical and cultural backgrounds. These courses were originally offered in an off-campus mode in which students received course packages via mail such as course materials, textbooks and video tapes and they participated in telephone-based discussions. Aoki, Fasse and Stowe (1998) pointed out that virtual universities are identical to traditional universities in the traditional sense. The key difference is that virtual universities do not require students to commute to campus and to physically attend classes. The rapid development of multimedia and hypermedia has provided universities with information technology which has transformed the traditional off-campus teaching into virtual teaching in which interaction is not only much quicker but there is great improvement of the quantity and quality of course delivery.

Courseware

The concept 'courseware' designates the method of course delivery via the Internet. A virtual class needs courseware, which guides and facilitates students' learning. Aedo, Diaz and Montero (1998) argue that 'a flexible CAL system should provide teachers with mechanisms to adapt the courseware to their own methods as well as their students' needs'. A courseware may include traditional reading materials. However, the fundamental difference is that it liberates learners from the traditional linear mode of learning. Fisher (1994) pointed out that computers have given users a power not widely understood till now; the power to break the enforced linearity of information, if not of time. The computer's ability to search far more quickly than any human can do makes possible an almost seamless presentation of information that can come from sources that are not only diverse, but that are invisible - and ultimately of no concern - to the user. There is no need to organise vast quantities of information in a strictly linear manner. The problem now is learning to think in such a way that this power can be put to use (Fisher 1994). However, there is still a danger that the old transmission model of one-way instructional delivery will be repeated, ignoring the importance of students' interaction and leaving students autonomous and isolated. Teachers can use the Web to place their course materials for students' retrieval, but still the Web may be a primitive media for creating an interactive learning environment (Aoki et al. 1998).

Learners' Evaluative View of the Web

One of the big shifts in educational theory and practice is the focus on learning rather than teaching. This shift has been reflected by the recent emergence of innovative concepts such as learner-centred, independent learning, process-oriented, negotiated-curriculum etc. The great attention given to constructivism in educational multimedia in the past decade has reinforced the premise that learners are the key players, not passive receivers, in the educational process. Teaching methodology, learning environment and teaching resources are critically considered to ensure that the new paradigm is not just 'old wine in new bottle'. However, curriculum innovation cannot meaningfully take place unless learners are allowed to play a part in the innovation process. The obvious step to be taken is to seek the views of learners on teaching and learning as they are 'real experiencers', not virtual beings. Their feelings and thoughts on teaching and learning should be the basis for curriculum innovation. In the context of Web-based education, the logical step is to conduct a study to find out learners' perception of the Web and its role in education.

Web-based Discussion Board

A big advantage of the qualitative over quantitative approach is that learners were encouraged to express as much as possible and as freely as possible their views on the use of the Web in teaching and learning. To achieve this, a number of discussions were conducted using the Web as a free and convenient forum for learners to voice their own opinions. A Web-based discussion board was created with the following features to ensure confidentiality and effectiveness.

- Participants were not required to identify their names and email addresses.
- Pseudonyms were encouraged to use to promote interpersonal communication. For example, addressing the other participants personally as 'Jim', 'Puzzled', ' T&T' etc instead of 'the previous writer', 'the first person in the discussion'.
- Informal discussion was the nature of interaction. Participants were encouraged to write down what came into their heads. They did not have to be concerned about grammar and spelling.

Discussion Format and Data Gathering

The data gathering was conducted as a normal learning activity in a university context.. Undergraduate and postgraduate students were invited to participate via the Discussion Board. Invitations were informally extended to students through their teachers in lecture times, notices on notice boards, and in public places such as canteens and sport events. Education students were particularly targeted as they were familiar with Web-based teaching and they were introduced to a courseware on communication as a component of their course.

There were three discussion topics covering four different aspects relating to the theme ' the Web and its role in education'. Each topic started with a discussion statement, which aimed at stimulating responses from learners. The three discussion statements were:

Topic 1: The role of the Web in education

The Web has been introduced to teaching and learning. Some people are very excited at the prospect that the Web will not be just another added tool to education but also present a significant alternative to the traditional face-to-face teaching and learning; while others are either unenthusiastic or sceptical about its educational significance. What do you think? Please share your views on this issue?

Topic 2: Critical Educational Web

Critical theory stresses the importance of critical examination of the nature of the discourse or the context in which teaching and learning take place. Such critical examination may reveal problems in education such as ideological imposition, misempowerment, imperialism, cultural insensitivity etc. Some people argue that the Internet or the Web can cause such problems. What do you think? Please share.

Topic 3: Learners in courseware development

Web-based teaching in the form of courseware has been introduced to tertiary education. Courseware is often constructed jointly by subject specialists and Web specialists to teach an on-line course on the Web. Some people argue that learners should be involved in the development and evaluation of Web-based courseware while others argue that learners' involvement is not necessary or impractical and we should have good faith in experts. What do you think?

Data Analysis and Results

The use of the discussion board in this study was to identify the meanings and concepts underlying learners' attitudes toward the use of the Web in education. Therefore the data collected from the discussion board were analysed in terms of conceptual issues which could be grouped under three headings: positive aspects, negative aspects and suggestions.

Positive Aspects

- The Web as a resource
- Non-threatening condition
- Choice and independence
- Interactivity with people
- Planning for the Web

Negative Aspects

- No virtual learners
- Ideological bias loaded
- Imperialism/ commercialism
- Unnatural/false pretending

Suggestions

- Experts & learners' contribution to courseware
- Learner as partners

Discussion Based on the Conceptual Issues

One of the advantages of a qualitative approach is that the focus is uncovering the meanings (concern, inspiration, mind-puzzling etc) which could not be captured easily in a quantitative study. These meanings are not necessarily in the imagination of the researcher when the research is planned and carried out. The following conceptual issues reflect strongly the meanings underlying the attitudes of the respondents.

Positive Aspects

Learners viewed the Web as a powerful resource, an inspiring teacher and an innovative device, which gives learners motivation, responsibility and independence in learning. The Web provides a dynamic discourse, which could not be replaced by the traditional face-to-face teaching. Learners can travel virtually in a world of knowledge and interaction. This positive evaluation could be demonstrated in the following selected responses from different learners:

- *The Web is a friendly forum. It is real to me, not artificial at all, no way!*

- *I feel more relaxed to discuss via the Web. It's fun. You don't feel as if someone would laugh at you. You have more time for thinking properly.*

- *On the Internet, I have the choice of selecting which issues to discuss and whom to discuss with. This is very important to me. I could not easily do this in a face-to-face situation. If you don't think this is real interaction, what else then!!!!*

- *We can exchange our views on various issues and aspects of life. We can chat on many things, which are of interest to us. You don't have to 'talk' if you don't feel like it. We talk about travel, cooking, politics, literature, science....If you think this is not learning, what is it then?*

Negative aspects

Some learners were not quite enthusiastic or optimistic about the role of the Web in education while others accepted the contribution of the Web in education but also pointed out some potential problems. Attention was given to the area of 'imperialist Web' and its ideology-loaded mission. This reflected their concern about the whole discourse of education to which the Web is attached.

- In face-to-face discussion, we can interact, I mean 'real' interact together. I enjoyed real group discussion. On the Web, all the personal things are not there any more. Of course, I still can do it on the Web, if I have to...but still it is not real interaction, is it?

- Everything we do, think, act reflect our culture, our attitudes, and cultural and social backgrounds. How could we leave all these behind when we travel on the Internet. Thus, teaching and learning on the Web cannot be immuned from cultural and social interference. We may think that we are neutral. I don't think so.

- When students come from different countries, different cultures, there must be some misunderstanding, misinterpretation, and all these can create mistrust, confusion and perhaps conflict.

- The Internet is a product of a commercial world. It is commercially motivated. The main aim of commerce is to make money. It is interesting to see how education with the use of the Internet can be free from commercial influences and controls? We need to look beyond the surface level to see how imperialism, in a new form, enters other human cultures. I think the Internet reflects the ideology of its masters. Just look at hardware and software! Where do they come from?

Suggestions

Apart from many responses, which reflect some concern as well as admiration for the Web and its role in education, learners also offered some ideas and reservations, which should be taken into consideration by Web instructional designers and teachers. Issues raised in their responses include the importance of partnership in Web-based courseware development, learning-centred approach of Web-based teaching, and learners' feedback.

- Navigation is an important feature and device. Some navigation on the Web are so well thought out that users can expand their learning and curiosity while travelling on the Www due to excellent design. I have come across many Web sites, which are technically very complicated, but educationally they are hopeless

- I don't think that we should allow experts to control our destiny. We should take an active part in it.

-'Learners are partners'? As partners, they must be involved partially or wholly. Of course, not everyone wants to be involved. It must be on a voluntary basis. Forced feedback leads to superficial results.

- I do well in subjects when lecturers give me flexibility, take interest in what I think. My feedback is always sought and valued. With this approach, I can learn so much.

The Web and Face-to-face Teaching

The Web has won the hearts of many university students who are trained to be teachers. It is clear from their messages that they have made use of the Web in the course of their learning at the university. The word 'however' was constantly in their consciousness when they discussed about the role of the Web in teaching and learning. In other words, there was some reservation about the idea that the Web can take over face-to-face teaching as seen in the following two responses from students.

- The first response emphasises the significance of social interaction which the Web could not adequately provide.
  The availability of the Web as a classroom tool is exciting! It is not only a way for students to be able to access up-to-date information, but for teachers as well. The Web is loaded with teaching ideas and lesson plans on almost any topic you can think of and there are of course the 'wonderous' mailing lists we all learned about last year which provide the opportunity for contact with fellow professionals. However, while an undeniably useful tool, the Web for me is not really an 'absolute' alternative for traditional face-to-face teaching. Today's society demands that the mastering of all types of personal interaction be included as part of a school's curriculum. But with the way technology is heading, the scary thing is that tomorrow's society may not...?
- The second response emphasises the access problem facing students and teachers.
  I don't think the Internet will be used to replace teachers, but they will become more important, especially when trying to get up-to-date information. I also think that even though the web has a lot of things to offer teachers and students alike, it also requires a fair bit of time to access and find the relevant information you need. Some teachers don't have that time with all the other requirements they have and this might be another reason why they hesitate to use the Internet in their classrooms.

The following response raised the problems of Web control and Web abuse in the class.

Although the web is an exciting new introduction into classrooms, I also believe that in some cases many students use it for their own entertainment purpose. This is fine if not in school and class time. But some of the material that these kids are getting hold of is just not suitable. The teachers and parents of these children should make sure that they have suitable blocking benefits such as net nanny or similar programs so that these sites are not available to younger children.

Conclusion

The Web has been introduced to education and its role has been subject to critical discussion by educational multimedia experts as clearly indicated by various papers presented at this conference and other similar conferences in the world. It is important for us to share our exciting experiences brought to us by educational multimedia. We may expect that the superhighway will bring more educational innovations to the world. However, the most important thing for us to remember is that the journey on this educational superhighway should include learners as our travelling partners. As one of the learners in this study has inspired us with the following statement: 'Virtual teaching is a fascinating growing area and I think we should support it. Support does not mean to learners are like obedient sheep which know nothing and are at the mercy of their master. They should be consulted if learning takes place meaningfully.'

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Web-Based Learning Environments (WBLE): Current State and Emerging Trends

David Mioduser, Rafi Nachmias, Avigail Oren & Orly Lahav
Tel-Aviv University, School of Education
Ramat-Aviv, Tel-Aviv, 69974, Israel
miodu@post.tau.ac.il

Abstract: The Web, today, is a firmly established (virtual) reality. A few years after its impressive break through, from limited professional circles to everybody's working and social life, the Web constitutes an additional space for people to communicate, work, trade or spend leisure time. And increasingly, too, a place to learn. We have currently reached a stage at which a mapping of Web-based learning environments (WBLE) is required to answer crucial questions at the content, teaching, learning and communication levels. To relate to these questions we developed a Taxonomy of WBLE's, implemented it for the study of about 500 educational Websites, and elaborated on practical implications of the study's results. The overall picture we have unveiled may sound deceptive, and can be summarized as "one step ahead for the technology, two steps back for the pedagogy". But a more thoughtful consideration of the results suggest directions for the further development of novel Web-based educational models.

The Web, today, is a firmly established (virtual) reality. A few years after its impressive break through, from limited professional circles to everybody's working and social life, the Web constitutes an additional space for people to communicate, work, trade or spend leisure time. And increasingly, too, a place to learn (Berenfeld, 1996).

Within the global network, already an unknown quantity of educational Websites of various kinds has been developed, and their number is daily growing. These Web-based learning environments (WBLE) reflect educators' attempts to wrap together Web technology features (e.g., information manipulation, communication, and creation tools) according to their educational and pedagogical beliefs in pursue of learning goals. The sites differ from each other for instance in terms of the identity of their originators (e.g., teachers, students, development centers, research centers) and their goals and motivations, in regard to subject matter, focus (e.g., communication, information retrieval), pedagogical approach, or learning activities. An obvious result of this variability is the uneven educational value and quality that characterizes the growing aggregate of educational sites.

Given the continuous increase in quantity and diversification in quality, and the high level of expectations in the educational community regarding the educational potential of the Web technology, we have reached a stage at which an appropriate mapping of the WBLE landscape is required. Key questions to be answered in the mapping process are:

- *What characterizes educational Websites at the content, teaching, learning and communication levels?* (Detailed mapping of relevant features)
- *What is the current overall picture of the educational Websites field regarding key teaching and learning issues, vis-a-vis the educators' expectations?* (Overall analysis and evaluation of trends and solutions)
- *What can be concluded from the current state of affairs as a basis for the further development and implementation of educational Websites?* (Practical implications and conclusions)

To answer these questions we developed a mapping or classification scheme, the Taxonomy of WBLE (Nachmias, Mioduser, Oren & Lahav, in press), implemented it for the study of about 500 educational Websites, and elaborated on practical implications of the study's results. In the following sections, we will briefly describe our classification scheme, we will present the study and its findings, and finally we will discuss key issues resulting from the observed picture and suggest directions for further development of WBLE.

Taxonomy of WBLE

For this study we developed a classification scheme or taxonomy of educational Websites aimed to reflect the developers' educational philosophies as well as their actual manifestations, by revealing how different functionalities are configured, the knowledge is structured and represented, and communication features are implemented. Our taxonomy characterizes an educational Website by about 100 variables regarding four main dimensions: basic descriptive information (e.g., site ID, updating, population); pedagogical and educational considerations (e.g., instructional model, interaction, cognitive processes); knowledge attributes (e.g., representational structure, navigation tools); and communication features (e.g., types of telelearning, communication means). For a more detailed presentation of the taxonomy's rationale, background and description refer to Nachmias, Mioduser, Oren & Lahav (in press).

Method

Five evaluators acted as research assistants. All five are students in the graduate program of Communication and Computers in Education in Tel-Aviv University School of Education, have scientific background, and are currently science educators. First, each evaluator was assigned to find about 100 educational Websites meeting all following three criteria: (a) It was deliberately developed for educational purposes; (b) Its topic is clearly defined (in this study the area of science, technology and mathematics teaching was selected); and (c) it is clearly identifiable as a unit as opposed to "mega-sites", links-repositories, or general-access-sites to conglomerates of projects or web pages. In this process 524 sites were initially selected, and at the end 436 Websites were included our final sample. Sample selection took place in March 1998.

Following this stage, each one of the five evaluators received about 90 Websites, randomly selected from our list, to be characterized according to the Taxonomy of WBLE. All the evaluation process was carried during April and May 1998. By June 15th 1998, the database of 436 Websites by all taxonomy variables was completed. In order to assess the validity of the database, a sample of about 25% of the Websites was analyzed once again by a different evaluator.

A detailed presentation of the results is beyond the scope of this paper (see Mioduser, Nachmias, Lahav, & Oren, 1988). In the following we present and discuss a selected sample of findings.

Results and Discussion

The transition of the Web technology from its early rudimental stages to the current "everyone-can-do-it" stage, generated high expectations among educators. These expectations relate to the Web's potential impact on educational processes in three main domains fostering (a) the raise of new pedagogical forms emerging out of unique features of the technology (a "Webagogy"?); (b) the development of improved information-organization, representation, and handling capabilities; and (c) the enhancement of communication processes among students and teachers and support for collaborative learning. Our aim in this study was to assess the extent to which educational Websites, these sites deliberately developed for educational purposes realize the potential and fulfill the expectations.

Pedagogical Characteristics of WBLE's

Current pedagogical approaches support learning processes that include the student active involvement in the construction of knowledge, her interaction with peers and experts, the adaptation of instruction to individual needs, and new ways to assess the students' state of knowledge and learning. Our expectation was that the development process of educational Websites would reflect these approaches. Moreover, given the innovative character of the technology, it could be expected that even new pedagogical forms based on the unique features of the technology would arise.

Notwithstanding, the results indicate that this is not the situation (see Table 1). Only 28.2% of the sites include inquiry-based activities, and more than three-quarters were highly structured placing the control over the learning process mainly on the computer side. Most sites elicit cognitive processes such as retrieving information (52.5%) or rote learning (42%), fewer focus on analysis and inference processes (32.6%) and even less on problem-solving and decision-making (5%). Only a few sites include student-modeling and adaptation mechanisms. In addition, and considering the fact that network technologies appear to be ideal milieu for the implementation of collaborative work, it is highly deceptive to find that only 2.8% of the sites support any form of collaborative learning. These results conclusively show that the pedagogical approaches favored by educators and researchers for the development of valuable learning environments are still far from being implemented in most educational Websites.

The gap is even more evident if we take in account the accomplishments reached within the digital-technology-in-education field in its previous form, namely (non-networked) instructional software. Regarding interaction types, we found that most sites include browsing (76.4%) or simple forms of interaction (42.4%), and few sites offer complex (3%) or even on-line (6.4%) activities. Few sites include any form of feedback, either automatic (16.3%) or human (5.5%). Most sites offer resources and means related to information handling (65%). Only few offer the student online tools (12.8%) or resources external to the site itself such as resources in other sites (31%) or experts (8.7%).

		Yes	No
Instructional configuration	Individualized instruction	407 (93.3%)	29 (6.7%)
	Classroom collaborative learning	54 (12.4%)	382 (87.6%)
	Web collaborative learning	12 (2.8%)	424 (97%)
Instructional model	Directed	330 (75.7%)	106 (24.3%)
	Inquiry-based	123 (28.2%)	313 (71.8%)
Instructional means	Information-base	283 (64.9%)	153 (35.1%)
	Tools	56 (12.8%)	380 (87.2%)
	Structured activity	211 (48.4%)	225 (51.6%)
	Open-ended activity	43 (9.9%)	393 (90.1%)
	Virtual environment	30 (6.9%)	406 (93.1%)
	Student modeling/adaptive mechanism	0 (0%)	427 (97.9%)
Interaction type	Browsing	333 (76.4%)	103 (23.6%)
	Multiple choice question	137 (31.4%)	299 (68.6%)
	Simple activity	185 (42.4%)	251 (57.6%)
	Complex activity	13 (3.0%)	423 (97.0%)
	On-line tool	28 (6.4%)	408 (93.6%)
	Expert consultation	58 (13.3%)	378 (86.7%)
Cognitive process	Information retrieval	229 (52.5%)	207 (47.5)
	Memorizing	183 (42.0%)	253 (58.0%)
	Information analysis and inferencing	142 (32.6%)	294 (67.4%)
	Problem solving and decision making	22 (5.0%)	414 (95.0%)
	Creation and invention	20 (4.6%)	416 (95.4%)
Locus of control	Student controlled	377 (86.5%)	59 (13.5%)
	Software environment controlled	77 (17.7%)	359 (82.3%)
	Mixed initiative	26 (6.0%)	410 (94.0%)
Feedback	Automatic	71 (16.3%)	365 (83.7%)
	Human asynchronous	17 (3.9%)	419 (96.1%)
	Human synchronous	7 (1.6%)	429 (98.4%)
Help functions	Technical help	91 (20.9%)	345 (79.1%)
	Contextualized content-help	152 (34.9%)	284 (65.1%)
	Didactic help	73 (16.7%)	363 (83.3%)
Learning resources	Within Website resources	363 (83.3%)	73 (16.7%)
	Linked WWW resources	135 (31.0%)	301 (69.0%)
	Additional external resources	93 (21.3%)	343 (78.7%)
	External resources only	4 (0.9%)	432 (99.1%)
	Real time data collection	6 (1.4%)	430 (98.6%)
	Ask an expert	38 (8.7%)	398 (91.3%)
	Ask a peer	17 (3.9%)	419 (96.1%)
Evaluation	Standardized tests	29 (6.7%)	407 (93.3%)
	Alternative evaluation	7 (1.6%)	429 (98.4%)

Table 1: Websites analysis for the pedagogical dimension

Pre-Web (digital) educational materials present fascinating examples of the multiple ways educators succeeded in harnessing the new technologies to educational needs and goals (e.g., constructivist environments, intelligent tutoring systems, sophisticated multimedia learning environments). Against this rich background, and looking at pedagogical qualities and resources, the vast majority of educational sites prove to be the unripe fruits of the promising but still immature Web technology.

Information Representation and Handling

In cultural terms, in our digital times the visual-world (e.g., still images, icons, video-clips, animated graphics. movies) has reentered the scene in stronger presence and linguistic status and meaning than in its pre-Gutenberg incarnation. High-level and sophisticated integrated-media is perhaps one of the defining characteristics of state-of-the-art Websites today. But again our results showed that educational Websites march behind (it should be noted that we are not looking after educators' technical –and even pyrotechnical- use of imaging technology, but after their use of visual languages). The vast majority of sites are still heavily based on text (93% of the sites include more than one text field in all its pages). About 58% of the sites include at least one image per page; most sites do not include interactive images (96.1%), animated images (81.9%), or sound (see Table 2).

	Not at all	At list one in the site	50% of pages in the site	One per page	More than one
Text	2 (0.5%)	0 (0%)	3 (0.7%)	24 (5.5%)	407 (93.3%)
Image	63 (14.4%)	64 (14.7%)	55 (12.6%)	117 (26.8%)	137 (31.4%)
Interactive image	419 (96.1%)	9 (2.1%)	1 (0.2%)	1 (0.2%)	5 (1.1%)
Animation	357 (81.9%)	35 (8.0%)	18 (4.1%)	18 (4.1%)	8 (1.8%)
Sound	426 (97.7%)	6 (1.4%)	1 (0.2%)	2 (0.5%)	1 (0.2%)
Real-time updating	431 (98.9%)	0 (0%)	3 (0.7%)	1 (0.2%)	1 (0.2%)

Table 2: Representational means in educational Websites

Regarding structure and organization of knowledge, the Web is the realization of the hypertext (or hypermedia) model. Non-linear structure, complex linkage within and between information units, and appropriate navigation and search tools are defining features of this model. Our results reveal only a shallow presence of these features in the evaluated Websites (Table 3). Only about half of the sites included within-the-site linkage to a reasonable extent (more than one link per page), and about 11% of the sites refer to other sites (external linkage) at the same extent.

	Not at all	At list one in the site	50% of pages in the site	One per page	More than one
Within the site	116 (26.6%)	32 (7.3%)	20 (4.6%)	50 (11.5%)	218 (50.0%)
Links to external sites	253 (58.0%)	68 (15.6%)	37 (8.5%)	32 (7.3%)	46 (10.6%)

LINKS TO:	**Yes (N of sites %)**	**No (N of sites %)**
external databases	74 (17.0%)	362 (83.0%)
external tools	12 (2.8%)	424 (97.2%)
external activities	42 (9.6%)	394 (90.4%)
virtual reality devices	8 (1.8%)	428 (98.2%)
human communication	25 (5.7%)	411 (94.3%)

Table 3: Link structure in educational Websites

Communications

The results of this study show that limited communication resources were used in most Websites (Table 4). The most (and almost sole) resource present in the sites is electronic mail (about 65% of the sites). Other tools such as discussion groups, chat, or any form of distant work (e.g., tele-manipulation, tele-creation) were found only in a few sites. Moreover, features aimed to support working groups or learning communities were not found in any of the evaluated sites. The gap between expectations and actual implementation in the communications domain is even more evident than in the previously discussed domains. The main reason for that is that the technological resources do exist and are being successfully implemented in other areas of people's life (e.g., work, professional training, banking, shopping). In addition, transactions among humans and between humans and information resources are quintessential to education, and it is not hard to conceive endless forms of support that communication technology could offer for these processes. As for today's reality, this support is not yet a function in most educational Websites.

	Yes (N of sites, %)	No (N of sites, %)
Synchronic activities	17 (3.9%)	419 (96.1%)
Communication means		
e-mail	283 (64.9%)	153 (35.1%)
Discussion group without mediator	15 (3.4%)	421 (96.6%)
Discussion group with mediator	10 (2.3%)	426 (97.7%)
Chat	8 (1.8%)	428 (98.2%)
Moo/mud	0 (0%)	436 (100.0%)
Video conference	0 (0%)	436 (100.0%)
Tele-manipulation	1 (0.2%)	435 (99.8%)
Tele-creation	7 (1.6%)	429 (98.4%)

Table 4: Use of communication resources in Websites

Conclusions

One step ahead for the technology, two steps back for the pedagogy. One can depict that way the usual loops affecting the educators' assimilation process of new technologies for the last decades. As experienced educators we hold substantial models regarding the varied facets of our practice (e.g., how to build a lesson plan, to assess a learner's performance or behavior, to develop a learning unit). These models are usually tied to the (technological) resources at hand, and they affect each other mutually. It seems reasonable to assume that when facing the assimilation of a new technology we use these models as input to the process. The result is usually a transition period at which we replicate the known models by means of the new technology. While first assimilating the computer technology developers replicated the programmed instruction paradigm by means of the new technology, initially in the form of electronic worksheets and booklets then evolving in time into sophisticated drill and practice and structured tutoring software (Venezky & Osin, 1991). Our claim is that this study reveals a similar transitional phenomenon regarding the vast majority of educational Websites. Most sites' main component is the information-base, built upon the hypermedia-CD model (even a feature with can be claimed as unique to the Web, as the linkage to external sites, is today included in many hybrid CD-Web products). As for interactivity features based on the implementation of new technological resources (e.g., forms, Java applets, Shockwave), most online activities resemble the automatic-feedback (behaviorist-like) transactions of classic CAI (e.g., multiple-choice, select-correct-part, assemble-correct-configuration).

In light of these results one can adopt the skeptics' perspective and argue that Web technology has little to offer to education. But one can also adopt a more thoughtful perspective, reflecting on the character of this transition stage and generating new possible models and trends based on substantial educational needs.

The authors are part of the community of educators dealing with the problematic involved in the assimilation of Web technology to education (Mioduser & Oren, 1998; Nachmias, Mioduser, Oren & Lahav, in press). Although in this study we have referred to the educational Websites population in quantitative terms, we are aware that a number of fascinating examples of high pedagogical-quality sites do exist in the Web. But our main purpose in this study, rather to focus on the exceptions, was to map and learn what most existing sites and current trends as they are delivered to cyberspace have to offer to educators and learners. Based on this and similar studies, the next steps should focus on the research and development of novel Web-based educational models (Windschite, 1998) and on the implementation of a revised configuration of the technology-assimilation evolutionary loop: two steps ahead for the pedagogy/technology, one step back for reflection and mindful planning of subsequent steps.

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Virtual University: Real Challenges

Professor Stephen Brown
Head of Learning Technologies
De Montfort University,
The Gateway
Leicester LE1 9BH
UK
sbrown@dmu.ac.uk

Abstract: Many Higher Education institutions are responding to external pressures by developing an on-line presence. Coincidentally changes in pedagogy are demanding the kinds of functionality offered by on-line learning delivery and support systems. Creation of a virtual university is not a simple transformation from old methods into new media and for traditional universities there is a high degree of risk in developing an off campus, on-line operation. De Montfort University's Electronic Campus is a hybrid approach which aims to re-purpose and integrate existing teaching with new on-line methods as far as possible in order to achieve maximum flexibility of access for existing on-campus students. Given limitations on resource availability, existing resources need to be re-engineered to bring them into line with the chosen venture. This entails obtaining the support of staff at all levels through a conscious programme of culture change, which is described here.

All Change

There is a growing belief that learning is a key to economic success and competitiveness, whether at the level of a company, an individual, or the state. Knowledge is rapidly outdated in a fast changing world, employees need to enhance their attractiveness through periodic self development and employers need to update he skills of their workforce in order to remain competitive (BCC 1998) (IoM 1998). Notwithstanding local labour shortages in the United Kingdom, there is a developing surplus of people combined with a declining number of jobs overall (DfEE 1998a).

The appearance of corporate universities such as Unipart 'U' (http://www.unipart.co.uk/97report/ugc97.htm) and the British Aerospace Virtual University (http://www.bae.co.uk) are manifestations of these concerns and of a growing sense that industry needs are not being adequately met by traditional education and training providers. Recent UK initiatives such as the proposed University for Industry (DfEE 1998b) and Lifelong Learning reflect similar concerns at Government level.

At the same time change is being driven from within as traditional models for mass higher education based on behavioural theories give way to more learner centred and resource based philosophies (Hardy 1997). Learner centred approaches seek to accommodate individual learner needs and acknowledge that learners may have other calls on their time. This leads to more flexible delivery and support strategies which allow learners to shift the time, place and pace of learning. Rigid classroom timetables and enrolment schedules become more relaxed, allowing for multiple delivery of the same curricula at different places at different times. The role of the teacher shifts away from that of expert instructor to learning facilitator. Involvement of the learner in the development of the learning experience necessarily requires the 'teacher expert' to relinquish control and allow others (learners) to contribute (Laurillard 1993). The rapid development of digital, networked multimedia technology such as the Internet, email and computer based and video conferencing assist with this process and at the same time open up opportunities for learners to seek out and utilise learning resources offered by other parties (Bacsich 1998).

Competition, Globalisation and Commoditisation

In the UK, per capita spending on Higher Education students declined by 20 per cent between 1991/2 and 1996/7 (THES 1998), stimulating greater competition between universities for resources. Competition is not just local. UK Higher Education providers are facing increased competition in traditional overseas markets as well, where countries such as the USA and Australia are vigorously recruiting students whom might have otherwise studied in the UK. Many overseas governments are seeking to expand and enhance their local provision instead of sending such large proportions of undergraduates to study abroad, e.g. India, Singapore, Hong Kong, Indonesia, South Africa. From the UK perspective the recent appearance of 'virtual', 'on line' universities such as Western Governors' University (www.wgu.edu) and Colorado University's CU Online (www.cuonline.edu), with their potential to deliver globally, are cause for concern. Commercial on-line organisations such as Phoenix University (www.uophx.edu), or ZD University (www.zdu.com) are further indications of the possible shape of things to come.

Re-inventing the University

All of the above factors are driving Universities to reconsider their roles and methods. What is clear is that new ways have to be found of carrying out at least some of the functions of traditional universities and that overall new ways of doing things will have to cost less than traditional methods. In the absence of significant sums of new money to effect change, the task facing universities today is how best to re-engineer the resources already at their disposal to deliver and support the changes needed.

Many traditional Higher Education institutions are seeking to create some kind of on-line presence. Forbes magazine in the US has published a guide to the 'top 20 Cyber-Us', compiled by Ebeling and Bistayi (1997). Philips and Yager (1998) have published a guide to virtual university study opportunities which profiles 195 accredited universities offering over 1000 distance learning courses. On the face of it, becoming a virtual university appears to be straightforward. Bacsich (1998) has observed that the following methodology is generally accepted:

- Lecturing maps to videoconferencing
- Tutoring maps to computer conferencing
- Books map to CD-ROM and the Internet

However, when one takes a closer look at the reality of virtual university provision to date it is interesting to note how much of it depends on older technologies including books, video, and residential periods on campus as well as videoconferencing (Ebeling and Bistayi (1997), Philips and Yager (1998). There appear to be a number of good reasons why established, traditional Higher Education providers should hold back from large-scale conversion to on-line delivery. These include: the high costs of courseware development; the longer development timescale and relative inflexibility of resource based learning compared with face to face classes; shortages of appropriate ICT infrastructure; staff concerns about the impact of new technologies on their own jobs and on the quality of the student learning experience; and management concerns about the possible consequences of failure if large scale investments do not deliver the required competitive advantage. Also, traditional universities have strengths that are, by definition, missing from cyberspace: physical locations that provide a respite from the everyday demands of home and work; facilities and equipment that are not readily simulated in virtual space; people with whom to socialise, enjoy physical contact, chance encounters, etc.

In seeking to retain the benefits of a traditional university, minimise the risks of a virtual enterprise, while obtaining some of the advantages of on-line delivery, De Montfort University has opted for a hybrid model. The Electronic Campus is an Internet based addition to the face to face delivery and support systems of the university that is intended to enhance flexibility of access to learning *on campus*. In an era of lifelong learning, increasing numbers of individuals are likely to need to access educational opportunities for irregular periods, fitting in with domestic and employment commitments. Even traditional full-time students increasingly have to fit their studies around paid work in order to finance their education. Fixed attendance at lectures, limited opening hours for buildings, communication via notice boards, face to face meetings, seminars and tutorials all create barriers to flexibility of access. Restricting the Electronic Campus to on-campus students may appear at first to be paradoxical. However the rationale for this decision follows logically from the earlier discussion regarding the risks of going virtual. On campus access ensures that the benefits of a traditional style university are retained, with the addition of some of the benefits of on-line access.

The University has a threefold strategy for achieving this goal, involving a combination of in-house development, importation of resources developed elsewhere and collaborative development ventures with other organisations. While the University has aspirations to produce as much of its own material as possible, it is recognised that on our own we are unlikely to be able to achieve a significant shift in favour of telematic methods within a reasonable timescale. More rapid transition can be achieved by leveraging the resources of other organisations, either by importing their materials or through collective, collaborative effort to jointly produce new materials. However, in order to establish a basis for collaboration, potential partners have to have something to share. So in the first instance the emphasis has been on the first two strands of the strategy: in house development and importing.

Progress to date

In the first 22 months over 30 different Electronic Campus development projects have been established, ranging across all Faculties and at all levels including further education, undergraduate, postgraduate and continuing professional development. Some of the projects are complete courses, some are full modules and others are parts of modules. Students started to study the first of these modules during the first semester of 1998 and at the time of writing the total number of students studying on-line is over 1500. In most cases projects have been based on resources already developed in the university and in areas most likely to have maximum impact on students and staff. The learning activities modelled include lectures, seminars, tutorials, practical assignments and cognitive assessments. Materials produced include pdf documents, straight HTML pages, web interfaced databases, including image databanks, and on-line assessment exercises, plus on-line computer conferencing, videoconferencing, FAQs, e-mail and synchronous 'chat'. Projects underway will generate video and audio files as well.

In addition to these in-house projects, the University has been actively embedding into the curriculum learning resources which have been developed at other institutions under the auspices of the UK Teaching and Learning Technology Programme (Scott et al 1998).

In setting up the Electronic Campus initiative, care has been taken to address key issues identified as crucial to success in earlier studies (Brown 1997), in particular:

- Future proofing
- Staff attitudes
- Champions
- Learning support

Future proofing

Standards offer the potential of savings through reduced staff development costs and bulk purchase discounts. They can also reduce the learning curve for inexperienced development teams. Off-set against this is the risk of committing too early to inappropriate tools. The common core of all the Electronic Campus projects is HTML compliant content, enabling material to be accessed from a variety of different platforms via the Internet. HTML was adopted as the standard delivery environment in order to future proof the investment as far as possible. Variations such as Java, XML, DHTML, etc. have been avoided for the time being to ensure that material does not acquire obsolescent legacy status as technologies change in the medium term future.

Staff attitudes

Awareness of the Electronic Campus has been raised through separate meetings with all Deans of Faculties, presentations to senior staff down to the level of Heads of Departments, development of an Electronic Campus web site, publication of articles in the university in-house newsletter (13 so far) and through direct liaison with Faculty members via dedicated central staff with appropriate skills and experience (the Learning Development Managers described below). The Web site (http://dld.mk.dmu.ac.uk/ec/frame/frameset.htm) provides access to news about Electronic Campus developments, virtual university developments elsewhere, relevant professional associations, funding opportunities, tools and learning resources, staff development opportunities and to newsgroups concerned with on-line educational developments.

Within a university context the opportunities for direct financial reward are much more constrained than in industry, however it has been possible to put in place a number of incentives. Pump priming funds have been made available centrally for Faculties to bid against. This money can be used to buy equipment, software, travel, learning resources, staff development and staff time. In practice 78% of the project money allocated to Faculties has been used to buy out staff time to release staff from other duties, particularly teaching. In addition, the University *performance related pay* scheme and the University *promotion* system have been examined to identify ways of explicitly encouraging and supporting the development of teaching excellence. New categories of teacher status have been introduced in anticipation of the accreditation system to be introduced by the Higher Education Funding Council for England Institute for Learning and Teaching.

Care has been taken to ensure that involvement in Electronic Campus activities is as easy as possible. A proforma set of questions guides Faculty staff through the selection criteria applied to proposals for funding. Each Faculty has been allocated a specific, individual, Learning Development Manager, to work with them to:

- Develop appropriate teaching, learning and assessment strategies.
- Develop teaching and learning proposals for internal and external funding.
- Identify and obtain resource based learning materials produced elsewhere.
- Develop and implement learning support strategies and systems.
- Identify and meet staff development needs in relation to implementation of the Electronic Campus.

Learning Development Managers (LDMs) are members of a central curriculum design and production team with educational technology and curriculum development and delivery expertise.

As far as possible, on-line materials have been developed by Faculty staff themselves using simple, readily available tools such as Microsoft Office and Adobe Acrobat. Microsoft Office products were selected as general development tools for their familiarity, ubiquity and simplicity of use, compared with professional authoring tools and programming languages. Given the aim of ensuring that as much of the development as possible could be undertaken by Faculty teaching staff, it was important to avoid creating barriers such as the requirement to learn specialised software packages. Adobe Acrobat was adopted as a means of readily converting large quantities of existing text based documents to HTML readable form. Where more sophisticated products have been required, the LDMs have liased between faculty colleagues and central support teams to provide services using more advanced, professional tools. LDMs provide ongoing assistance with learning materials design and production and a link back to the central production resources (graphic design, courseware authoring, programming, desk top publishing, audio, video and photography, digitising, print, etc.).

Staff development has been identified as another important *enabler*. Electronic Campus staff development is a combination of formal training events and informal problem based learning. For example a programme of formal IT staff training courses has been restructured to provide basic technical authoring skills using Microsoft Office products and more advanced Internet training including HTML authoring, web site development, Internet communications and information search techniques. Project teams are also offered short courses on the use of specific software applications used within the Electronic Campus. Informal development takes place through interaction with the LDM, beginning with the project proposal proforma which encourages teaching staff to consider learning objectives, pre-requisites, relationship with other courses, assessment strategies, teaching methods, learner characteristics and requirements.

Champions

A vital ingredient of change seems to be the presence of enthusiasts in key positions within the organisation with the authority, charisma and skills to both push and facilitate the change process (Brown 1997). The Electronic Campus initiative is led by a Pro Vice Chancellor, supported by a Steering Group, made up of key university senior staff including the Director of Learning Development. Reporting to this group is an Operational Group of managers from key operational areas (Library, Information Services, Educational Technology, Learning and Teaching, Digital Library), charged with identification of implementation issues and solutions in response to steering group policies and strategies. A link between the Operational Group and the Faculties is provided by the LDMs and their Faculty counterparts: Teaching and Learning Co-ordinators. Successful project bids result in the formation of Project Teams within faculties, supported by the Faculty LDM. There is therefore an unbroken chain of champions from the Vice Chancellor down through the organisation to the grass roots of course design and delivery.

Learning support

The quality and availability of support for learners appears to be a vital ingredient for successful independent learning (Laurillard 1993). For this reason emphasis has been given to the development of on-line student support systems using email, computer and videoconferencing. First Class conferencing software is the standard for computer mediated communications within the Electronic Campus. It has been in use within the University for four years, supporting teaching and learning on a number of courses. The University now operates six professional level videoconferencing suites across its main campuses and after some experimentation with different systems has standardised on Picturetel equipment. In addition Microsoft Netmeeting is being trialled on a number of Electronic Campus modules to evaluate its potential for remote class rooms utilising its desk top video and audio conferencing features, combined with application sharing. Web CT is being trialled on two projects to evaluate its effectiveness as a fully integrated on-line course development, delivery and support environment, including conferencing.

What works

While it is too early to make definitive judgements about the effectiveness of the Electronic Campus, it is possible at this stage to comment on the planning implementation process in term of what has worked:

1. Pump priming the innovation to make it easy for Faculty staff to get involved and for resource managers to sanction their involvement. Also to make available additional central resources beneficial to the innovation, e.g. Software site licences for software packages adopted as standards.

2. Maintaining central control over project budgets has enabled close monitoring of expenditure against agreed schedules and deliverables.

3. Faculty based projects and development teams ensures local relevance and ownership and hence commitment and enthusiasm.

4. Establishing identified individuals to work with specific Faculties in an account management type role has developed stronger links between the central support services and Faculties and encouraged a culture of innovation and creativity.

5. Focussing on HTML as the primary medium for delivery and support has helped to simplify the decision making and development process. The choice of medium sets priorities for infrastructure investment, software tools and staff development and defines useful parameters for functionality.

6. Concentrating on unsophisticated, readily available, development tools, such as Microsoft products, ensures that all staff have easy access to them and where necessary, training courses can be made available easily and cheaply.

7. Adoption of a formal process of bidding for identified resource has made the activities of the central teams more visible, accountable and legitimised them to a degree not previously possible.

Conclusions

Re-inventing the university as a hybrid face-to-face/on-line institution is more than just a technical challenge. It requires a culture change which needs to be led from the top, through an unbroken chain of champions down through the organisation, including the resource managers at middle management level. Key factors to pay attention to are staff attitudes, future proofing and student learning support. It also needs to be able to draw on and re-purpose resources already available within the organisation. Because of the large, distributed, nature of De Montfort University it has long had a need to research and exploit the benefits of networking and resource based learning. In the past, small scale, bottom up, experiments in videoconferencing, Computer Mediated Communications, computer marked assignments, video, print, CD ROM and Internet delivered course materials have tended to have only a minor, temporary impact on the organisation because of their inability to succeed in re-engineering sufficient resources to achieve lasting institution-wide change. Other parts of the organisation have tended to resist changes not central to their own goals. At the time of writing (October 1998), the Electronic campus initiative appears to be successful so far in converting these unrelated initiatives into a coherent, management led, university wide programme. During the next twelve months the challenge will be to embed the Electronic Campus activity further into the normal processes of the university.

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The Troubleshooter.

The Acquisition of Troubleshooting Expertise in a Virtual Environment

Eric Jutten
Multimedia Opleiding & Training
Veldsingel 120
NL 6581 TD Malden
e.jutten@worldonline.nl

Alma Schaafstal
TNO Human Factors Research Institute, The Netherlands
Schaafstal@tm.tno.nl

Peter Pel
CINOP, Centre for Innovation of Training, The Netherlands
ppel@cinop.nl

Abstract: A project is described in which a virtual environment is combined with an intelligent tutoring system for troubleshooting. The virtual environment enables the student to perform troubleshooting activities in a realistic job-situation. The intelligent tutoring system takes care of the learning process, and offers structured guidance and feedback throughout the troubleshooting process. In doing so, a system has been realized that helps to bridge the gap between vocational training which is theoretical and general in nature and the knowledge and skills required in actual job situations. It also helps in raising the attractiveness of training.

1. Introduction

There exists a widely known gap between the contents of vocational training and the knowledge and skills needed in actual job situations. This gap shows itself in a number of ways. The knowledge acquired during vocational training is often rather general and theoretical in nature, leaving the transfer to the real-world practice to practice periods. Students often complain about the fact that they see only a minor relationship between what is trained in schools and what is needed in the actual job context. Employers, on the other hand, have a problem in hiring rightly trained personnell, and have to put in a lot of effort in preparing new employees for their jobs. Another problem, especially with respect to vocational training for the technical subjects, is the mismatch between the number of students in training, and the number of technicians needed in the job market. There is much more demand for technicians than the schools can actually deliver.

Why is it that an insufficient number of students, men and women, choose for technical vocational training, while on the other hand there are plenty of possibilities on the job market afterwards? What can be done in terms of training to raise interest in the technical subjects and to increase the attractiveness of education? One of the answers to this question may be found in establishing a strong relationship between what is trained in schools and what is needed in actual job contexts. Multi-media programs in which a strong link is provided between realistic job situations and the knowledge and skill to be acquired in training environments, could be a strong means to bridge this gap, and thus to enhance the attractiveness of training. The program Attractive Vocational Training , partly sponsored by the dutch government, aims at exactly reaching this goal: establishing a stronger link between training and job contexts, thereby making training more attractive, and thus providing a strong motivator for upcoming students to choose for vocational training.

The Troubleshooter project, partly sponsored by the above mentioned program Attractive Vocational Training, is an example of a multi-media virtual environment, to be used in vocational training, that is able to train students a complex cognitive skill, troubleshooting, in a realistic situation. It combines a virtual job environment with an intelligent tutoring system, that guides the student through the various parts of the problem solving process, and depending on the progress made in learning acts more as a formal coach or as an advisor. The multi-media virtual environment , enables the student to move around freely in a particular simulated building, and act as a realistic troubleshooter in a realistic environment doing realistic jobs, including having conversations with other (simulated) people in this environment, using appropriate documentation, telecommunication facilities, tools etc. This has resulted in an attractive training program in which a realistic job-environment is provided while on the other hand strongly promoting a structured acquisition of troubleshooting skills.

This article will describe the background of the Troubleshooter in some detail. In paragraph two, the method for training of troubleshooting is described. Paragraph three describes features of the virtual environment, while paragraph four will go into some detail about the interactions between the intelligent tutoring system and the virtual environment. Finally, in paragraph five some conclusions are drawn.

2. Training of Troubleshooting: A Structured Approach

Structured Troubleshooting: The Method

The TNO Human Factors Research Institute, on behalf of the Royal Netherlands Navy, has carried out a study into the possibilities of improving the troubleshooting performance of technicians by means of innovating the training practices. The project started with a cognitive task analysis of troubleshooting on board of naval frigates. As part of this analysis we investigated how well technicians were able to solve problems that they were confronted with, coupled with an investigating into the problems at a cognitive level that they have in terms of troubleshooting performance. This analysis showed problems on at least two levels: 1. Beginning technicians lack a systematic approach to troubleshooting, resulting in a lack of goal-directed troubleshooting, and 2. They lack a functional understanding of the installations that they have to maintain (Schraagen & Schaafstal, 1996). These conclusions are remarkably similar to results of Schaafstal (1993), obtained in a rather different domain: troubleshooting in a papermaking installation. These findings have resulted in a number of recommendations for the training of troubleshooting of which the most important ones are:

The training of a structured approach to troubleshooting should be embedded in regular training courses, in such a way that this structured approach becomes a "second nature" of technicians, and is fully integrated in training courses on maintenance of particular installations. For reasons of transfer, it should not be the case that there is a separate course on structured troubleshooting, apart from the 'regular' maintenance courses.

What is meant by this structured approach ? Cognitive task analyses of expert troubleshooters in various domains reveal highly similar strategies in troubleshooting across domains. This strategy consists of four steps: 1. Formulate problem description. 2. Generate causes. 3. Test. 4. Repair and Evaluate.

Ad 1. Formulate problem description

The process of troubleshooting is started when the technician observes abnormal system behaviour or receives a notification of abnormal system behaviour. Besides recognising abnormal behaviour, the technician also needs to identify correct phenomena. This is an important task because determining correct phenomena can limit the number of possible causes. By determining what phenomena are still normal, the technician eliminates certain parts that do not need to be investigated further.

Ad 2. Generate causes

Generating possible causes is a task that can hardly be subdivided further. A distinction can be made between familiar and unfamiliar problems. In case of familiar problems, causes are generated mainly by a process of recognition. A particular combination of normal and abnormal phenomena functions as a cue for the retrieval of a particular cause from memory. For instance, the technician notes that the TeleTypeWriter does not print 'application'. Based on his experience, he knows that this symptom is most often caused by a faulty DCL TTW. A technician who encounters this phenomenon for the first time needs to use reasoning skills and schemata in order to find out whether the phenomenon is caused by the DCL TTW or the TTW itself.

Ad 3. Test

When possible causes have been generated, they need to be tested. The technician needs to choose the right testing method and the right testing equipment. By 'testing equipment' we mean all tools and equipment that can provide clarity to a technician concerning the status of the system. The next task is performing the test. This amounts to the correct setting up and operating of testing means and the correct reading of the outcome of the test. After this, the outcome of the test needs to be interpreted. This implies that the technician needs to formulate an expectation before performing the test and subsequently relates the outcome of the test to this expectation. If a technician expects, on the basis of the proper functioning of the system, a low level (0V) and he measures and observes a high level (5V), then the cause that was tested needs to be accepted, provided all boundary conditions for the proper execution of the test have been fulfilled. If, however, on the basis of the outcome of a test, a possible cause is rejected, the next possible cause needs to be tested. When all possible causes have been rejected, the technician needs to back up to the task of generating causes, since he has probably overlooked something. When the correct cause has been identified, it needs to be evaluated.

Ad 4. Evaluate
If a technician thinks he has identified the correct cause, this cause needs to be eliminated. The goal of troubleshooting is to return the system to its normal state of working, which asks for a thorough check for system functioning.

The knowledge of installations should be taught at a functional level, not at a component level.

A structured approach to troubleshooting should not be trained out of the context of a particular system, but, to enhance transfer, should always be tuned towards a particular system. What are the normal characteristics of a particular system, e.g. an overheadprojector.

The method is supported by the use of a fault isolation form, that is filled in during troubleshooting sessions. This forms keeps the students on track, prevents them from forgetting important results gained sofar, and is therefore an important aid in preventing working memory overload.
The results of this method, more thoroughly described elsewhere (Schaafstal and Schraagen, 1998) show an enormous improvement in performance. Subjects trained in the new method solve twice as many problems as before, and take less time for troubleshooting. Apart from this, there is a significant improvement in the quality of reasoning and the quality of system knowledge

The Pedagogical Approach in The Troubleshooter

The method described above functions as the main guide for troubleshooting in the troubleshooting system. The implemented fault isolation form, which has to be filled in while troubleshooting, is an important tool in determining the progress a student makes in troubleshooting, and explicating the underlying level of knowledge and skill, including bugs and misconceptions. The evaluation strategy follows from an overlay model, in which an ideal and expert solution is compared to the students solution. This does not imply that only one solution is allowed at any point: in fact, if there are more good moves possible at a particular point in the troubleshooting process, they are all allowed.
Students can choose between a strongly guided method or a free method of solving problems. In the guided manner, the student is very strictly evaluated in his use of the fault isolation form and is given appropriate feedback after finishing each stage of the problem solving process. If he makes really bad mistakes, he receives feedback right away. At the end of a case, an overall feedback is given to evaluate the students performance in troubleshooting.

The troubleshooter contains over fifty problems with various variations, and with a varying level of difficulty. A preset selection can be made for particular types of problems (e.g. only problems with the overheadprojector), and for problems with a certain level of difficulty. This ensures that the chances of students getting bored, because they encounter the same problems repeatedly, are low.

Since the training of troubleshooting is embedded in a realistic environment, not only troubleshooting in a strict, technical sense can be trained, but attention can also be given to training and emphasizing the right attitude of student-troubleshooters towards end-users and training them in communicating (e.g. asking the right questions when setting up a problem description).

3. The Virtual Environment in The Troubleshooter

The virtual environment in The Troubleshooter was modelled after a real building, housing an educational institute. It consists of an enormous amount of photographs, which, taken together, make up a realistic environment, containing of classrooms, corridors, elevators, staircases, offices etc. The possible objects for troubleshooting in this building are coffeemakers in various locations, lighting, overheadprojectors in the various classrooms, and a stereo-set. Of all the technical systems, installation documentation is available, which can be taken with you on your way to a particular problem. There are maps available of the layout of the building, test equipment is available, and communication with other people, e.g. end-users complaining about malfunctions is possible through simulated conversation.

4. The Interaction between the Virtual Environment and the Tutoring System

A session with The Troubleshooter (after having completed a sign-up procedure) starts with some notice that there is some system malfunctioning in the building. The task of the chief technician/maintainer (i.e. the student) of the building is to take action and provide adequate solutions and repairs, with the right priority. To accomplish this task, he may ask questions to the complaining person through the phone, write down notices, go to the piece of equipment, open it, take measurements, undertake repairs. While collecting information leading to a problem description, making decisions with respect to the likelihood of certain causes, while collecting measurement information, he fills in his fault isolation form. As soon as the troubleshooting session starts, the behavior of the student is monitored in the background by the tutoring system. Only if the student makes really bad mistakes during troubleshooting (as described above), or after having finished a stage in troubleshooting, he receives an qualitative evaluation of his behavior: what went well, what went wrong, has the student performed sufficiently good to progress to the next phase of the problem. After finishing the problem the student receives an end-evaluation: what went well, and what could be improved in his reasoning throughout the troubleshooting session.

5. Discussion and Conclusions

We believe that the combination of a virtual environment and an intelligent tutoring system is a powerful tool in training a complex cognitive skill such as troubleshooting. It enables training in a realistic job-context, not only concentrating on the technical skills that are needed in a particular domain, but also emphasizing other important skills in job-environments, such as communication skills. In doing so, we believe that multi-media environments are a powerful tool in enhancing the transfer from vocational training to job-related expertise and in increasing the attractiveness of training.

Of particular importance in the project was the approach to troubleshooting that we implemented: it provides a firm grip on the students learning process, and enables intelligent and informative feedback, thus maximizing the possibilities for students to learn.

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Cooperation, Collaboration and Communication in Educational Multimedia Design and Development Teams

Sara McNeil
Deaprtment of Curriculum and Instruction, College of Education
University of Houston
Houston, Texas USA
smcneil@uh.edu

Gita Varagoor
Medical Educator, University of Texas-Houston Medical School
Houston, Texas, USA
email: gvaragoo@dean.med.uth.tmc.edu

Abstract: This study reports preliminary findings about critical factors that promote and facilitate collaboration, cooperation and communication between members of design teams who create educational software for classroom use. Factors that discourage or contribute negatively to group interaction and production were also considered. Methods employed included pre- and post-team surveys, peer reviews, participant interviews and journals, and observations. Participants were graduate students in the Instructional Technology program in the College of Education. Although multimedia design teams in commercial settings have been the focus of many articles in business publications, there is little research-based literature about teams composed of educators developing courseware for classroom settings. In order for multimedia design teams to work together effectively, members must possess effective and well-developed skills of collaboration, cooperation and communication. Understanding how these skills may be developed and nurtured plays a critical part in courseware development and may facilitate a more effective model of instruction.

In the business arena, multimedia design teams have been used extensively over the past decade to develop software for commercial purposes. In educational settings, however, most courseware has been developed by individuals who, for the most part, do not have the wide range of skills needed to produce a quality product. By working in multimedia design teams, educators can combine their skills to produce both a worthwhile and well-designed piece of software expressly for their educational setting.

This study reports preliminary findings about critical factors that promote and facilitate collaboration, cooperation and communication between members of design teams who create educational software for classroom use. Factors that discourage or contribute negatively to group interaction and production were also considered. Methods employed included pre- and post-team surveys, peer reviews, participant interviews and journals, and observations. Participants were graduate students in the Instructional Technology program in the College of Education. The students were enrolled in two sections of an instructional technology course, CUIN 7327, the Design and Development of Instructional Packages during spring semesters, 1996 and 1997. In 1998, this course was renamed to more closely match course objectives and divided into two courses which are taken in a fall-spring sequence, CUIN 7327, The Collaborative Design of Multimedia, and CUIN 7357, The Collaborative Development of Multimedia. Data was also gathered from the fall, 1998 section of this two sequence course. The students who enrolled in these classes were from a variety of backgrounds, but most had teaching experience in either K-12 classrooms or in higher education.

This project fits into a larger research focus on educational multimedia courseware development and authoring competencies for educators. Although multimedia design teams in commercial settings have been the focus of many recent articles in business publications, there is little research-based literature about teams composed of educators developing courseware for classroom, not commercial, settings. In order for multimedia design teams to work together effectively, members must possess effective and well-developed skills of collaboration, cooperation and communication. Understanding how these skills may be developed and nurtured plays a critical part in courseware development and may facilitate a more effective model of instruction.

Educational Multimedia

Using the computer to control and deliver a full range of audiovisual media offers educators a way to regain the power and strength of audio, video, animations and interactive simulations, and to build those features into educational materials. These materials actively engage students by giving them the best possible presentation and explanations with whatever media are the most suitable to the task. Interactive multimedia implies multiple forms of communications media, controlled, coordinated and integrated by the computer. The computer allows the individual user to interact with and control the flow of information. Instead of reading the information in a conventional linear way, the user is encouraged to pursue links from one topic to another following a uniquely personal trail through the information. The user becomes an active participant in the flow of the narrative, actively choosing material, and in some cases, modifying the content itself to suit his or her needs and interests.

In the past few years there has been a dramatic growth in the interest and possibilities of using multimedia in educational settings (Ferretti, 1993). However, Wiburg (1995) noted that although there are thousands of articles about multimedia, there is very little research. In addition, Wiburg continued, much of the research that does exist about multimedia has been conducted in other areas and is peripheral to the concerns of most educators.

Effective Use of Technology

There are many viewpoints on the competencies that educators need to effectively use computer technology in their classrooms. Teacher education organizations have proposed that educators should have, "The ability to integrate instructional technology into the classroom to facilitate interdisciplinary teaching and learning, supplement instructional strategies, design instructional materials, and enhance hands-on experiences and problem solving" (National Council for the Association of Teacher Education, 1992) and "demonstrate knowledge of uses of multimedia, hypermedia and telecommunications to support instruction" (International Society for Technology in Education, 1992). D'Ignazio (1993) stated that multimedia has a great potential for educators at all grade levels by bringing even "the driest areas of curriculum to life" and by turning the classroom in "an exciting studio-like area" (p. 490).

Authoring Courseware

Lockard, Abrams, and Many (1997) listed several reasons why teachers may find it advantageous to develop their own software. First, teachers may not find appropriate software. Educational software companies must develop software that meets the needs of many students in order to be cost-effective. Second, budgetary considerations may prevent teachers from purchasing a commercial software package. Third, educational software is not designed with specific students and individual needs in mind. Finally, teachers may have a personal preference for creating their own materials including the natural desire of experienced teachers to produce their own educational materials of all kinds.

Teachers are logical developers of courseware for their classrooms. They have a better knowledge of the content than do commercial software designers, and they bring to the authoring environment their knowledge of good pedagogy and teaching skills. Teachers also have the concrete experience of actually teaching the content. They have learned by experience what strategies work and which ones must be reinforced in multiple ways. Teachers understand the needs of their audience better than anyone else. Many teachers may actually prefer to develop their own materials just as they do with other classroom materials such as handouts and worksheets. Kearsley (1986) suggested that teachers should author their own programs in order to become better software evaluators. He stated that the ability to distinguish a good software program from another is one of the critical skills needed by software designers. He continued by adding that evaluation skills and design skills are mirror images of one another. Finally, teachers are the ultimate users of the software.

As early as 1984, researchers have cited the need of some teachers for producing their own software and have contended that software development is a valid topic for teachers to study at the graduate level (Young, 1984; Monahan, 1987; Overbaugh, 1994). In addition, Turner and Dipinto (1992) stated that hypermedia gave students new insights into writing. Using hypermedia caused students to view information as more than large streams of text, but more as chunks of information that were linked. Turner and Dipinto reported that the study indicated that "the time students invest in learning to use software and hardware not only gives them a powerful new medium of communication but may also give them new insights into organizing and synthesizing information" (p. 198).

Multimedia Design Teams

In spite of these compelling reasons for educators to author courseware for their unique classroom environment, it is not reasonable to expect that educators will be able to produce professional looking courseware taking into consideration both the limitations of time and production capabilities. The range of skills needed to produce a multimedia project include a detailed knowledge of computers, information processing, graphic design, sound and video editing, an authoring language, and instructional design. It is practical, therefore, to view the development of educational courseware much like the development of commercial software utilizing the concept of multimedia design teams with specialists in the various production fields.

A design team usually consists of several individuals with specific talents who contribute in some way to the development of a shared goal. Martin (1995) stated: "A team refers to a small, tightly knit team of people intensely focused on meeting a specified objective that all members of the team are committed to accomplishing together." (p.65)" In a successful and effective design team, each member feels a sense of trust, commitment, and responsibility for other members and a shared vision for team goals and objectives.

Multimedia design teams are, for the most part, organized around a project manager, an instructional designer, a graphic artist, an audio and video producer, a content writer and a programmer. Working with a client, the team develops learning materials that may include some form of computer-assisted software program, a manual or guide and a set of usually print-based teacher materials.

One of the most important factors in a team approach to courseware design is the interaction and communication among team members (Ally, 1985). Team members are required to work cooperatively and must learn to function as a unit. In spite of several different areas of specialization and different levels of interaction with one another, team members must be able to communicate ideas and meanings effectively.

In the business field, design teams may spend several sessions learning to work collaboratively. Unlike the highly structured procedures of cooperative learning, a collaborative learning environment empowers the learners to actively seek knowledge. Teams become more autonomous as they learn to work, interact and nurture each other while working toward the team goal. Bouton and Garth (1983) cited the fact that through a collaborative learning situation, the learners are transformed from spectators to being involved in more complex interactions in an active learning process.

This study investigated some critical factors that enhance collaboration, communication and cooperation among team members developing educational courseware. This research has implications that will impact both students and faculty in the design and development of educational multimedia courseware. Current trends in educational research indicate that the delivery of multimedia materials will increase over the next decade.

Research Design

Objectives

Goals for this study included:

1. determining those behaviors which promote group cooperation and those behaviors which contribute in a negative manner to teamwork and interactions
2. soliciting from participants ways that positive behaviors may be learned and developed
3. examining solutions to problems which occur between members of a team
4. creating guidelines and suggestions for promoting positive team interaction
5. suggesting what role previous team experiences may have on group communication and behavior

Procedures

Procedures included a detailed literature review concerning effective team qualities in multimedia design teams including those used in the business field, pre- and post-team surveys, peer reviews, participant interviews and journals, and observations. Participants included 42 students in two graduate instructional technology courses, CUIN 7327, the Design and Development of Instructional Packages during spring semester, 1996 and 1997, and 18 students in CUIN 7327, The Collaborative Design of Multimedia (renamed and redesigned fall, 1998).

The research plan began with an initial assessment of computer skills, multimedia skills and knowledge of team strategies based on two surveys completed by each group of students the first night of class. The Computer Skills Assessment asked students to rate their skills in such areas as proficiency in specific types of software programs and the ability to use hardware peripherals such as scanners and digital cameras. The Multimedia Skills Assessment asked students to rate their skills in areas such as the use of specific authoring programs such as Macromedia Authorware and Director.

In addition, this survey asked students to rate their multimedia project experience in such areas as designing navigational structures, building a prototype and producing video.

Design Teams

Based on this survey and student interviews, each class was divided into design teams consisting of the following members: a project manager, a graphic designer, a videographer, a programmer and a content writer. During the fall 1996 semester, four teams of five members each worked with four different faculty members to develop a multimedia project according to that client's specifications over the course of the fourteen-week semester. During the fall 1997 semester, four teams worked on different sections of a large project for one client. During the fall, 1998 semester, six teams worked with two different clients to design educational software for an undergraduate history class in the college of Humanities, Fine Arts and Communications and an undergraduate human resources class in the College of Hotel and Restaurant Management. The purpose of this project was to provide students with an introductory, but realistic, experience in developing a piece of software in a team environment for a specific group of users.

Design Process

Students were assigned to different teams based on the skills analysis they completed on the first night of class, the instructor's knowledge of each individual's background, and student preference. For the most part, the graduate students in this class had completed both the introductory instructional design course and overview of multimedia course.

The next few class sessions were spent on discussing team roles and developing competencies that would allow students to complete their part in the projects. Teams also met with their client weekly to discuss and develop preliminary analysis and goals for the project. Students soon realized that working in a team and trying to develop a piece of software for someone else is a lot of work.

Communication began to develop both in class team meetings and through email. One student noted: "I remember all of us being polite to each other at first. However, we had a lot of creative work to accomplish and 'polite' wasn't exactly what I had in mind from this team. But as soon as we got to know each other, our meetings became more open and lively." Another member of the team reflected," I found these discussions, sometimes heated ones, to be thought provoking and interesting. Ideas were put forth, discussed and then tested for consensus. We tossed a lot of ideas back and forth while we were trying to visualize how this product should look and what was needed to make it a reality."

In addition to communication skills, one student noted in his journal, "I've noticed that listening skills are especially important on a project team ... there are times in our groups where people don't stop to listen to each other's ideas and it really slows progress as we discuss (debate) a single item over and over. It's much easier when everyone takes a turn speaking, others listen, the issue is out on the table and a decision is made."Some problems were encountered when quiet students were reluctant to voice their opinions: "I believe other (students) have been frustrated or have kept quiet because of the vocal nature of a few members of the class."

Teams also foundered a bit at first trying to develop ideas and models for their projects. Members soon realized that decisions should be made by the team and not by individuals. It took most of the teams several weeks of meetings both as a team and with the client to develop a plan and direction for the projects. Some team members noted that success was related to early decision making, "We had to 'start from scratch' a few times, but those times were well justified - and were team decisions. It took us about two weeks before we settled on a direction. And we did not make a major change after that point."

Some teams spent several sessions establishing team rules for discussion; this usually facilitated decision making and communication. Although University of Houston graduate students usually work full time and often commute as much as an hour to come to class in the evenings, team members met many meeting requirements by using email.

Many students felt apprehensive about time considerations, working in a team situation and being evaluated by their peers rather than just the instructor, "I fear that the amount of time needed for production will be very demanding. The team process and work is worth the course alone! I'm learning tremendous lessons. It is also a very positive experience with each problem, group interaction, individual interaction building a team spirit. I like this!" A student remarked, "I think everyone is 'nervous' because the expectations of the finished product is high everyone wants to create something really good."

Student Resources

Several different types of resources were available for student learning. These included the textbooks, I Sing the Body Electronic by Fred Moody and Multimedia Making It Work by Tay Vaughn. In addition Web pages for each class were developed and used as means for sharing information and progress on the projects.

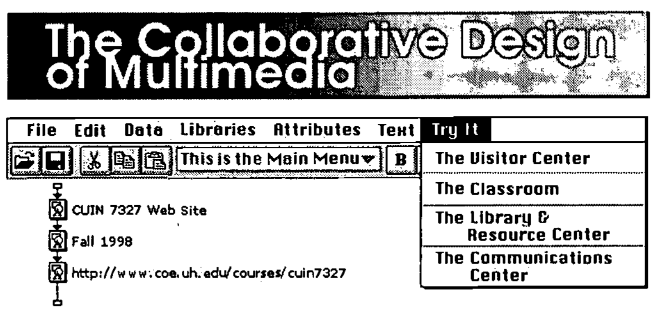

Figure 1.: Web Site for CUIN 7327 for fall, 1998 semester

Several students remarked on the Web pages in their journals noting, "The web pages have some interesting links and the material is organized in a logical and consistent fashion... The pages are a good way to stay connected to the class when at work or at home - important in creating a 'community' because of job or personal schedules."

To access the pages used during fall and spring, 1998: http://www.coe.uh.edu/courses/cuin7327

Hypergroups

In addition to face-to-face communication, Hypergroups, a web-based, hypertextual interface for the automated E-mail distribution lists was used to facilitate discussion among teams and clients. There were several discusison areas created. In addition to a common discussion area for all students, there were private, password protected, areas for individual teams.

Project Presentations

At the end of each semester, team members shared their final projects in a special evening presentation. Although the content and quality of each project differed greatly, the goals of the class were clearly met - students experienced working in an authentic learning situation. Several teams exceeded expectations in functioning as a cohesive unit noting, "We functioned as a team and not a collection of individuals. Our group rose to the highest definition of a team."

Preliminary Findings

In each semester, a mid-semester and final survey on Project Team Attitude was completed by each member anonymously. This survey has been adapted from closely related surveys used in business (Systems One, 1996). In addition, students participated in both mid-semester and final peer reviews. Peer reviews asked students to rate such competencies as "Quality of Assignments," "Responsibility to Team," "Contributions to Team," "Attitude," "Teamwork," and "Overall Team Member" for each member of the team and to also rate themselves. Comments at this time included, "My group is very eager and positive we feel a sense of 'group.' I still think we're showing our best selves."

Direct observation of team meetings and interviews with team members were also conducted by the researcher at critical milestones for courseware development over the course of the semester. In addition, team members were also required to keep journals of their thoughts and feelings during team meetings and other development opportunities.

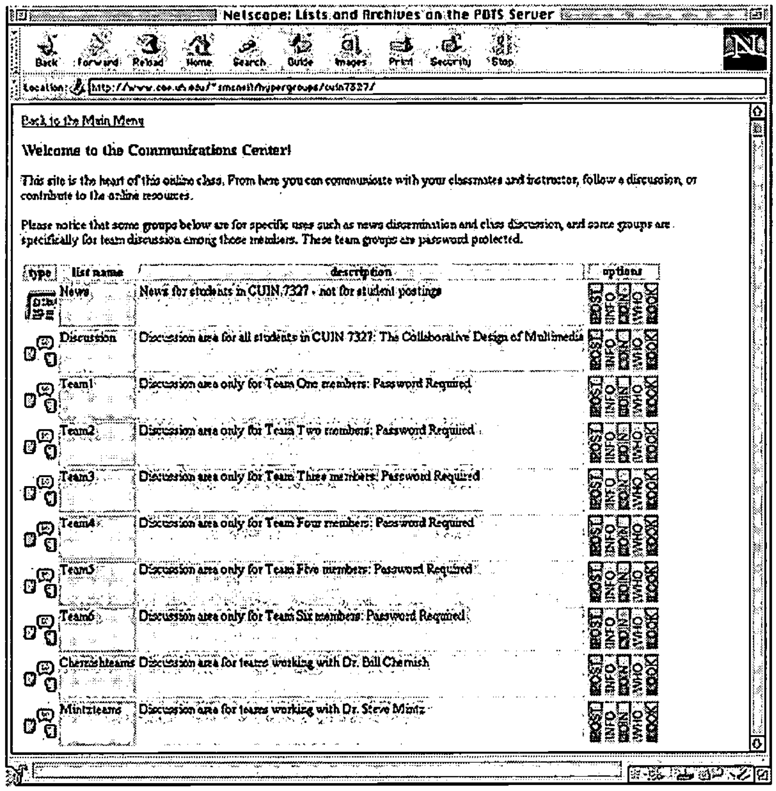

Figure 2: Hypergroups Menu for Project Teams

Midterm Evaluations

Participants used a likert scale to rate their perceptions of their team health and well-being. Using a scale ranging from 1 strongly agree to 5 strongly disagree, participants responded to such statements as: The goals of the team are clearly understood by team members. Team meetings are productive. I feel that I have been an important part of this team so far.

The highest disagreement among all teams was shown on statements such as, "The team is using their meeting time effectively." and " The team is learning to effectively address and resolve problems within the team." The most agreement among all teams occurred on such statements as, "The team is developing effective strategies to meet objectives," and "Team members are making efforts to get jobs completed." The ratings ranged from 2.65 to 1.85. These collective results, not individual ratings, were shared with the participants and strategies for facilitating better interaction and problem solving were addressed in a group discussion. At this stage in the project, there was a steep learning curve and many problems were being worked out, both with the clients and between team members. The overall attitude of the project teams ranged from 4 responses of excellent, 6 responses of very good, 4 good, and 4 fair.

Final Evaluations

Similar evaluations were completed at the end of each semester. As in the midterm evaluations, one of the highest areas of dissatisfaction among all teams continued to be, "The team is learning to effectively address and resolve problems within the team." The most agreement among all teams occurred on such statements as, I feel that I have been an important member of this team so far," "Team members are making efforts to get jobs completed," and "Team members have been generally positive in their outlook regarding the project." The ratings ranged from 2.09 to 1.52.

Peer Reviews

Peer reviews asked students to rate such competencies as "Quality of Assignments," "Responsibility to Team," "Contributions to Team," "Attitude," "Teamwork," and "Overall Team Member" for each member of the team and to also rate themselves. Consistently across all teams, team members rated their other members above average on most categories. Peer reviews in all three semesters of the course have proven very effective in addressing grading issues.

1998 Redesign of the Course

In the fall semester of 1998, the course was redesigned and divided in two parts which students take in sequence. Students had noted on their evaluations that the time was not sufficient to both design and develop the piece of software in one semester. Students now design the software during the fall semester. They develop it using Macromedia's Authorware and perform a simple evalution during the spring semester. This redesign has been very effective from both the students' and teacher's points of view. Because of the additional time, students have had more opportunities to both present and share informally knowledge of the instructional design process and authoring strategies. In addition, one client has been more involved in the process, learning the software and participating in both the design and development process every class. It is also interesting to note that team roles were not assigned during this semesterso that each team could develop the most effective structure for that particular group.

Discussion

Although many components of this research are still being evaluated and researched, it seems from a preliminary investigation that the areas of communication, collaboration and cooperation in a team environment are rich in experiences and nuances. Successful teams, as demonstrated in both project development and peer reviews, were able to work together and resolve problems quickly without any single person assuming a dominant or overpowering role. Teams that experienced some dissatisfaction with the team process typically did not form a cohesive group or work together to solve problems that arose. Although a leadership role is expected of the project manager, successful teams clearly developed a process for equal participation among team members. Further research is needed to explore other influences such as time constraints and different skill levels among members.

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Student Achievement in Distance Education Courses

Michael K. Swan
Washington State University

Diane H. Jackman
North Dakota State University

Introduction

As we enter the 21st century and embark on the information age, many institutions and schools are turning to technology to enhance their programs and to expand their horizons. Geography is no longer a barrier for preventing people from accessing information and education (Dixon, 1996). Rapid developments in telecommunication technologies, tightening budgets, and changes in student demographics have stimulated an increasing interest in distance education in all educational settings (Honeyman & Miller, 1993). Through the use of videoconferencing, computers, modems and the Internet, schools are able to deliver courses and degree programs to students in distance locations without requiring them to set foot in a traditional classroom.

Distance education is an emerging technology intended to deliver both resident and remote site instruction and educators who use distance education must provide educational experiences that will equal resident education in terms of quality and quantity. Both resident and distance education are intended to provide students with valid, useful information that promotes learning. According to Swan and Brehmer (1994), distance education refers to "the simultaneous delivery of instruction from a host site or classroom to remote site(s), coupled with real time live audio and real time live video interaction between teacher and student(s) – not correspondence, video, or internet courses." Distance education, according to the United States Department of Agriculture, is a process to create and provide access to learning when the source of information and the learners are separated by time and distance, or both. Rather it is the process of designing educational experiences that best suit the learner whom may not be in a classroom with an instructor at a specific time. Murphy (1997) defined distance education as a premeditated and persistent attempt to promote learning in an environment that includes geographic, temporal, or pedagogical distance.

Swan (1995) noted that advancements in communications technology have dissolved some of the major distinguishable characteristics between distance education and traditional education. According to Swan and Jackman (1996), strategies of teaching at a distance and host site are converging because traditional teaching strategies are being abandoned or modified in favor of a problem-based, resource-based, or activity based approach that de-emphasizes the teacher as the main source of knowledge.

The increasing availability of telecommunications has provided vocational or applied education faculty with unique opportunities to plan and deliver distance education courses and programs. Vocational education students are also enrolling in more distance courses and programs due to availability, time, and place. However, there is a lack of studies that compare student achievement by students receiving instruction via distance technology versus students receiving the same instruction through the traditional resident, host site, classroom setting.

Purpose/Objectives

The purpose of the study was to ascertain if student's achievement differences existed in courses delivered via distance education. Specific research objectives were:

1. Describe student's enrolled, remote site and host site, in distance education courses on selected demographic characteristics
2. Ascertain if differences existed between remote site and host site student's achievement based on grades/scores (GPA) obtained by grade level.
3. Ascertain if differences existed between remote site and host site student's achievement (final grade received) based on individual course success.

Methodology

Definitions

Host site: The school where the instructing teacher is residing or located and where the course originates from during the course sessions. Location where the instructing teacher is physically in the classroom with the students.

Remote site: The receiving classroom where the students are physically in the school setting but the instructing teacher is teaching students via an electronic format. Location where the instructing teacher is not physically in the classroom with the students

Populations

The population of remote site and host site schools was identified from an alphabetical list of secondary schools utilizing distance education technologies supplied by the State Department of Pubic Instruction. The schools were all located within one Midwestern State. Each of the identified schools administration were asked to participate in the study. From the total list of schools using distance education, a total population of schools willing to participate were identified, N = 46 schools. From this revised list of schools, a study sample was selected using appropriate cluster sampling methods outlined by Wiersma (1995).

As each school was selected, all courses/classes being offered via distance education from that school were selected for this study. Each student in the study, n = 623, was enrolled in at least one course being offered via distance education. To retain the confidentiality of the student, administrators or the assigned school representative was asked to assign an identification number to each student. This number was used to report all data concerning that student. The researcher did not know or have knowledge of any student name, only their assigned number.

Instrumentation / Data Collection

The study instrument was completed from student's records by the administration or assigned school representative. The instrument was assessed for content and face validity by graduate students, teacher educators, and state supervisors in vocational education. This procedure was followed because more than one person in a school was responsible for providing the data required by the researcher. Reliability of the instrument was .89 (Cronbach's alpha coefficient). They were asked to report gender, grade level of student, period(s) taking distance education courses, name(s) of specific distance education course(s), location of student (remote or host site), total daily assignment scores, exams and/or quiz scores, and final exam score.

Data Analysis

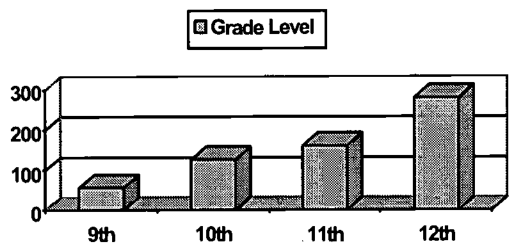
Data were analyzed using the Statistical Package for the Social Sciences (SPSS Version 6.1) for Windows. All tests were run at the .05 alpha level.

Results

Objective 1: Demographic Characteristics

Demographically, students in the study were predominately located at remote sites, 68.1% (424), and 31.9% at host sites (199). In the study, there were 245 male students (39.3%) and 378 female students (60.7%). The study identified ten individual courses being offered via distance education, one course was eliminated from the study because no results were made available to the researcher. Table 1 identifies the total number of students by grade level, 9^{th} = 56 (9%), 10^{th} = 126 (20.2%), 11^{th} = 161 (25.9%), and 12^{th} = 280 (44.9%).

Table 1 Grade Level of all Students



As shown in Table 2, the study group is divided into groups identified by specific course name and by location receiving the course. Frequencies and percentages are used to identify students enrolled in distance education courses all sites in the study.

Table 2 Individual Course Enrollment Frequencies and Percentages

Course Name	All Sites		Host Site		Remote Site	
	N	%	N	%	N	%
Foreign Language	231	37.1	91	39.4	140	60.6
Ag Business Mgt.	77	12.4	3	3.9	74	96.1
Vocational Marketing	21	3.4	14	66.7	7	33.3
Natural Resources	42	6.8	4	9.5	38	90.5
Math - Calculus	119	19.1	63	52.9	56	47.1
Chemistry	70	11.2	9	12.9	61	87.1
Art	14	2.2	5	35.7	9	64.3
Statistics	14	2.2	6	42.9	8	57.1
Animal Science	35	5.6	4	11.4	31	88.6
Total	623	100	199	31.9	424	68.1

Objective 2

One way analysis of variance was used to test if differences in student achievement existed between remote and host site students based on mean GPA. No significant differences were found.

Table 3 identifies the mean Grade Point Average (GPA) of students located at remote sites and at host sites. The grade point averages of students enrolled in distance education courses at both the remote and host sites were very similar.

Table 3 Grade Point Average According to Location Receiving Course

Location	N	GPA	SD
Remote Site	424	3.19	.76
Host Site	199	3.14	.84
Total All Sites	623	3.18	.78

ANOVA was used to test if differences in student achievement existed between grade levels based on mean GPA. There were significant differences among the four groups (9th grade, 10th grade, 11th grade, and 12th grade). The analysis of the data yielded an F value of 2.84 with a p of .037. Ninth grade students earned a GPA significantly higher than 11th grade students and 9th grade students earned a significantly high GPA than did 12th grade students as reported in Table 4.

Table 4 Comparison of students Grade Point Average by grade level and by site

Grade Level / Site	N	GPA	SD	SE
9th Host Site	2	3.35	.92	.65
9th Remote Site	54	3.43	.73	.09
9th Total	56	3.43	.72	.09
GPA / Grade Comparison 9, 10 p= .095, 9, 11 p= .045*, 9, 12 p= .005*				
10th Host Site	70	3.19	.71	.08
10th Remote Site	56	3.25	.58	.07
10th Total	126	3.22	.65	.05
GPA / Grade Comparison 10, 11 p= .712, 10, 12 p= .171				
11th Host Site	71	3.31	.57	.06
11th Remote Site	90	3.08	.79	.08
11th Total	161	3.18	.71	.05
GPA / Grade Comparison 11, 12 p= .297				
12th Host Site	56	2.87	1.16	.15
12th Remote Site	224	3.16	.78	.05
12th Total	280	3.10	.87	.05

Objective 3

One way analysis of variance was used to test if differences existed between remote site students GPA and host site students GPA by individual course. There were no significant differences among the two groups (remote site and host site). The analysis yielded an F value of .51 with a p = .47 as reported in Table 5. There were significant differences between the groups by grade level. The analysis yielded an F value of 12.23 with a p = <.0001. Analysis of data of student achievement (GPA) by remote site or host site by individual course identified no significant differences. The analysis yielded an F value of .77 with a p = .62 as reported in Table 5.

Table 5 Analysis of Variance for Grade Point Average on Site Location and Individual Course

Source	df	SS	MS	F	p
Site	1	.262	.262	.511	.4749
Class	8	50.194	6.274	12.231	<.0001
Site * Class	8	3.186	.398	.776	.6237

When comparing student GPA by course we see differences in individual courses. All courses GPA's were identified as being significantly higher than GPA's in Vocational Marketing. Foreign Languages GPA's were significantly higher then GPA's in Vocational Marketing. Natural Resources GPA's, Chemistry GPA's, and Art GPA's were significantly higher than GPA's in Foreign Languages. Natural Resources GPA's were significantly higher than GPA's in Ag Business Mgt., Math, and Animal Science as reported in Table 6. Significant differences were found when grouping traditional vocational courses, Ag Business Mgt., Vocational Marketing, Natural Resources, and Animal Science, together and comparing to the traditional academic in student achievement as measured by Grade Point Average. Students in traditional academic courses (3.25 GPA) had a higher GPA than did students in vocational courses (2.99 GPA). The analysis yielded an F value of 13.56 with a p = .0003 as reported in Table 7.

Table 6 Individual Course Success (GPA) by Host Site and Remote Site

Course Name	Host Site		Remote Site	
	N	GPA	N	GPA
Foreign Language	91	3.29	140	3.06
Ag Business Mgt.	3	3.23	74	3.09
Vocational Marketing	14	1.70	7	2.00
Natural Resources	4	3.68	38	3.43
Math - Calculus	63	3.11	56	3.21
Chemistry	9	3.57	61	3.58
Art	5	4.00	9	4.00
Statistics	6	3.50	8	3.50
Animal Science	4	3.43	31	2.88

Table 7 Analysis of Variance for Grade Point Average on Academic and Vocational Courses

Source	df	SS	MS	F	p
Between	1	8.18	8.18	13.56	.0003
Within	621	374.34	.60		

Conclusions

1. Students enrolled in distance education courses were primarily located at remote sites. Remote site students were provided the opportunity to take these courses because courses were being offered via distance education technology. Without this opportunity, most of these students (424) would not have been able to enroll in these courses
2. Receiving instruction by distance education resulted in no differences in grade point average for all students at either remote site or host site. Students in 9 th grade did have higher grade point averages then did 11 th grade and 12 th students. Twelfth grade students located at host sites had a significantly lower GPA than 12 th grade students located at remote sites. This area needs further analysis to determine exact reason for this occurrence.
3. Individual courses being offered via distance education revealed differences in student achievement. Grouping traditional academic courses and comparing to the vocational courses offerings significant differences were revealed.
4. The results of the study offer promise that distance education courses do provide opportunities for students who would otherwise not be able to take these courses. Additionally student success, GPA, was above average (mean GPA whole group = 3.18) in these courses.

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XML – A Solution for Publishing Up-to-date Educational Information on the Internet?

Ruairi O'Donnell, Crawford Revie, Monica Landoni, Colm McCartan
Department of Information Science
Strathclyde University
26 Richmond St, Glasgow, G1 1XH, UK
Email: ruairi@dis.strath.ac.uk

The Web was first envisaged as an Information Management tool that helped researcher organise and find interesting documents. However with the popularity of the Internet and the its image as a Publication tool for the masses, we now have a Information Mis-Management Tool. Increasingly people are using it for searching using "Web Portals". Web Surfers are morphing into Web Searchers. XML may help us resurrecting the information chaos into some manageable form. This paper will briefly describe XML and its potential benefits for Educational Delivery.

1 Introduction

The Web is based on technology, which was initially invented for small information spaces with a small number of users. HTTP, URLs and HTML are excellent solutions to a uniform information management system. With the Internet explosion these standards have been stretched to their limits.

The Web has evolved rapidly, so rapidly it seems more like a revolution rather then an evolution. To keep up with these changes the Internet authorities have had a busy time! Each of the original Internet technologies has been extended in numerous ways. HTML has seen the biggest change, initially designed for static text only hypertext pages, now incorporating many different technologies which want to get on the Internet bandwagon.

HTML has obvious limitations that need to be resolved. These limitations include:

- Unpredictable appearance of HTML documents in Web browsers;
- The content of an HTML document is inseparable from the presentation tags;
- Meta information in HTML is restricted to document wide semantic name/value pairs;
- The majority of search engines index only the textual content of HTML pages.

This paper will introduce the main elements of Extensible Markup Language (XML). The paper will outline a case for using XML within Courseware systems.

2 Case Study

The potential of XML to improve the delivery of course material is now illustrated through a short case study. The course under consideration is delivered by the authors to first year undergraduate students at the Business School of the University of Strathclyde, and provides an introduction to Business Computing.

Many of the generic issues relating to courses supported on the WWW are of relevance to this case study, including facilities for off-campus access, student centred learning, standard browser access, etc. However, there are a number of specific issues related to this course that make it particularly suited to web-based support. Firstly, it is a rather large class, by UK standards, with around 700 students. There is a need to give students, particularly in the first year, some sense of contact with teaching staff but it is clearly not feasible to use traditional small group meetings due to the time and labour intensity that this implies. Secondly, the course is delivered by four staff members from two different departments within the Faculty (it is felt that as this class is for all Faculty students this is a useful mechanism and indeed proposals are in place to increase the number of staff involved). In this context it is important that the students have a 'focal point' for the provision of course information. Finally, students entering this class come with a range of knowledge and skills relating to the use of computers within business. There is therefore a need to tailor material in such a way as to ensure that novices are not over-awed and yet. At the same time, to challenge those with some prior knowledge to extend and in particular deepen their understanding of the subject.

The use of web-based material aids in addressing a number of these issues for example, the web site provides a 'virtual' focal point to which the students can be pointed as a source of initial reference. In addition to finding a course overview, copies of the course handbook and timetable details, information can also be found for classes as they take place each week: tutorial material; preparatory reading; useful web links and even weekly student feedback can be checked on the site. When the 'virtual' solution cannot provide adequate support the site points the student to the most appropriate staff member to deal with their query and encourages e-mail contact in the first instance. The flexibility that the WWW provides to allow the four staff members to interact with the students and the course material, as well as with each other, has many advantages however it can also lead to problems.

The fact that no one person has overall editorial control can lead to conflicting information or to inconsistent presentation over a period of time. Thus there is a tension between the benefits, in terms of flexibility and immediacy, which the WWW offers and the requirement from the students point of view to be able to rely on the site as the authoritative source of course information. The need for increased control on the consistency and accuracy of information has been partially addressed by the creation of course 'style sheets' but this rather informal mechanism does not provide a complete solution and the potential of XML to assist in this context is explored below.

As yet, little progress has been made in addressing the widely differing levels of knowledge students have on entry to the course. This is not because the WWW does not provide suitable mechanisms through which diverse sets of material can be delivered but rather reflects the effort involved in editing and maintaining 3-4 parallel and internally consistent sets of material for the varying levels of student expertise. Once again it is the authors' view that the structuring and delivery of dynamically changing material (i.e. based on student expertise level) can be handled much more adequately using an XML-based approach.

3 XML

XML has generated a lot of attention in the technical press recently where it has been widely referred to as the replacement to HTML. The two languages are, of course, related and share a common parent in the Standard General Markup Language (SGML, ISO-8879). SGML is a complex standard in the form of a meta-language that allows us to describe how a document is structured by means of a Document Type Definition (DTD). A DTD specifies which tags a document may have, what they are composed of and how they are related to one another in the structure of the document in terms of sequence, nesting etc. HTML, for instance, is an SGML DTD defining documents for presentation by a web browser that is 'hard-wired' to understand the HTML DTD. Any users of the web over the last few years will have observed how HTML has been continually updated and expanded to increase its flexibility of presentation, its ability to integrate live data and its functionality for supporting interaction. However, these extensions, as well as being proprietary and non-standard, have been unable to tackle HTML's inability to support document extension or inheritance and its inclusion of document styling alongside structure.

Awareness of the limitations of HTML and the desire to avoid the proliferation of proprietary HTML extensions led to the ratification of XML by the World Wide Web Consortium (W3C) in February of 1998. In terms of complexity, XML lies somewhere between SGML and HTML and is aimed at providing most of the richness of the SGML command set while remaining easy to learn, implement and use. It has been described as a dialect of SGML and is itself a meta-language. Thus, XML allows us to specify not only a marked up document but also to specify which DTD it conforms to. For example, in the case of web documents, there is always an implicit association with the HTML DTD while with an XML document it is usually necessary to refer to the associated DTD explicitly in the header of the document.

This last point highlights what is probably the most important departure from HTML - that XML specifies the structure of a document via its accompanying DTD. Since the document author can define this DTD, any customised tags may be defined and used within the document. The XML markup language is robust enough to describe a wide range of abstract structures in the form of a document and an accompanying DTD describing that abstract structure. XML can therefore be used to describe data objects, structured records, and many other types of structured data. The industry has been quick to see the potential of this new standard for exchanging and sharing not only documents as is currently done on the Internet and various intranets, but also to share a huge variety of structured data using established Internet standards such as HTTP as the mediating protocols.

XML appears to offer a potentially industry-wide, customisable format with the robustness and flexibility to model a huge range of document types. It seems safe to suppose that support for XML in the form of toolsets and application suites will be forthcoming from an industry increasingly accustomed to and demanding of interoperability between vendors' products. A long list of "Who's Who" of software companies--including Microsoft, Netscape, Lotus, IBM, and Adobe Systems--have publicly committed to supporting the XML language.[1]

The three most important parts of XML are the Document Type Definition (DTD); the Extensible Style Language (XSL); and the Extensible Link Language (XLL) [Bradly 1998].

DTD - The Document Type Definition specifies the logical structure of a document. It defines the grammar of a document and enables an XML parser to validate a page's use of its tags. The DTD defines the permitted use of each tag and it's associated attributes. The DTD consists of three structures:

- A description of the nesting of hierarchies for document structures (i.e. A Chapter contains Headings and sections, sections contain paragraphs and so on.)
- The sequence in which the structures are permitted (i.e. A Title is before an Abstract and so on)
- Finally the DTD describes if structures are optional and also repeatable. (i.e. A Paragraph must have at least one or more sentences).

XSL - Extensible Style Language is the language used to specify style sheets for XML documents. XSL enables Web browsers to change the presentation of a document. This is similar to the Cascading Style Sheets (CSS) used in HTML 4.0.

XLL - Extensible Link Language supports today's Web links and it also extends links. It will include indirect links, which should resolve dead links and other hyper link problems. XLL is currently under development. XLL will support a number of link mechanisms [WWW3 XLL 98].

4 Internet versioning with HTML

For a corporate Internet to succeed the content needs to be up-to-date. Most companies have data and information stored in vendor specific file formats, such as Microsoft Word, Corel Draw, etc. For these file formats to be stored on the corporate Internet requires exporting to HTML and then FTP or "Published" to a Web server.

HTML is a poor presentation language with little or no structural information. Sadly most HTML file exporting tools remove important semantic information, stored in vendor specific file formats. Vendors are producing new software tools that can export to HTML but these are merely add-on features. For an Internet to succeed vendors must create software that use a Web file format as the primary file format. In time software vendors will become Web centric, until then we have a versioning problem.

IMAGE NOT AVAILABLE

Figure 1.1 illustrates the current situation when an employee saves a Microsoft Word document on a Corporate Internet. This two phased saving & publishing to the Web means that there are always two versions of the document which can lead to versioning control problems. HTML files are secondary file stores, much like a printed document,

[1] For more information on XML have a look at http://www.xml.com/

if the original document is updated then the HTML document must also be changed. For an Internet to succeed then the primary file store, on the Web, must be stored for company access.

5 XML Benefits

We propose storing vendor specific file format in XML. The software vendor can add all the extra "proprietary" information within the file format using XML. Then this XML document can be downloaded and interpreted by any XML compliant Web viewer. Thus we have a vendor neutral viewing facility, allowing users to have thin-clients with few installed programs.

Figure 1.2 shows that vendors can publish the DTD for a document and allow many users to view the information in its full glory. The DTD specifies the complete semantic of the document. In its purest form, XML will allow software vendors to create complex document viewers.

Another advantage of XML is that the appearance of the document can change depending on the media, allowing the document creator to harness all features of each medium. An author must customise a document for a single media and hope that it looks well in different media. Potentially, a single XML based document can take advantage of all the features of a specific printer and all the benefits of a Web browser. Also XML documents can be customised to a number of users, a manager may view an executive summary of a project report while the project team views the complete report.

Research by [Rath 98] has highlighted that XML can assist in the Management of Content, where the document content can be maintained by editorial support systems. Also Metadata can be incorporated into the XML documents so that the documents can be easily indexed and searched. Information stored in a database could also be used by XML documents by enhancing the tag definitions for Database elements such as table names and fields.

Data delivered in XML to a browser can "give Java something to do". This would mean XML could convey data and data types to a browser in a standardised form. In the past migrating data between systems has either been impossible, because proprietary software actually prevented batch upload and download, or it has been a tedious process of reducing complex data formats to flat structures like comma-separated variables. In this process there are ample opportunities for sophistication in the data structure to be lost. XML promises to be the lingua franca for data migration

5.1 Standardised DTDs for XML

For XML to succeed the domain specific DTDs must be globally accepted within a particular domain. There is little point developing numerous DTDs that describe Educational Course Material as we could then have incompatibility issues between the different Educational DTDs. For XML to succeed then there must be some central standards organisation that controls the evolution of one single DTD for a particular Domain such as Educational DTDs. In other Domains XML DTDs are under development, these include:

- Mathematics Markup Language (*MML* used for displaying Math symbols and equations etc)
- Chemistry Markup Language (*CML* to describe molecules and their structure etc)
- Electronic Document Interchange (*XML-EDI*)
- Channel Definition Format (*CDF* used for some 'Push' technologies)
- Synchronised Multimedia Integration Language (*SMIL*)
- XML Metadata Interchange (*XMI* used for exchanging software models)

We propose developing a standard DTD for courseware systems.[2]

5.2 Developing a Courseware DTD using Visual Rhetoric and existing Learning Models

We are currently developing a generic Courseware XML DTD that will allow us to create re-usable Courseware systems. To do this we are using a Graphical User Interface model called Visual Rhetoric to define how course

[2] We are interested in developing a Standard XML DTD that can be widely used. If your Organisations is interested in helping develop this Courseware DTD please contact us.

content should be presented. We are also hoping to improve the quality of the information delivery by using existing learning methods to develop XML DTD tags.

A document can be interpreted as a visible representation of a text according to its semantic contents [Southall 89]. The use of different fonts and typographical styles, as well as the introduction of spacing and pagination rules helps to draw attention to selected parts of the text [Southall 92]. Thus the translation into graphical terms of the text rhetoric which results from both the logical structure of the text and its pragmatic component can be called visual rhetoric [Landoni 97]. The idea is to define those parts that are more important for the comprehension of the meaning of the text.

Visual rhetoric provides the reader with a graphical mark up language that is immediately recognisable on the basis of previous reading activity. Different graphical presentations suggest different readings and affect deeply the interpretation of the contents of the same text. These observations lead one to conclude that visual rhetoric is a crucial aspect for both reading and browsing a document. We will be adopting this approach visual rhetoric when developing the XSL and XLL that will define the presentational aspects of the DTD. It is hoped that visual rhetoric will give us the possibility to control/predict the way student interprets and interacts with the Courseware documents.

One of our main goals is to improve we improve the effectiveness of a Courseware system. A DTD that uses 'semantic elements to exploit knowledge inside the information' can help increase the quality of the data and the service of online information [Rath 98]. At present we are identifying teaching models that encapsulate most learning methods and teaching techniques. We will then create XML tag definitions that correspond to each element of these teaching models. It is a relatively straightforward task to translate each of the teaching elements into DTD tag definitions. However developing a DTD from scratch is time consuming, and requires a great deal of testing [Maler 96].

6 Commercial acceptance of XML

Many software vendors are investigating XML as the future file format for universal viewing, editing and saving. "XML can potentially revolutionize the Web," said Chris Lilley, from the World Wide Web Consortium (W3C). "It's not a magic bullet ... but as a cornerstone of an open network computing environment it's very important." Microsoft's plans a new HTML-XML hybrid file format and both Lotus and Corel plan to support XML in their next releases. It could eventually supply the basis for universal file formats usable by all suites [PC World 98].

Berners-Lee [Montgomery 98] is optimistic about the use of XML markup tags outside the Web. This will overcome the problem of backward incompatibility between document formats. The W3C is talking to Microsoft Corporation about using XML as a cross-platform file format for Word. Berners-Lee suggests that HTML will remain reasonably static at Version 4.0, as XML allow vendor to extend and customise tags for specific purposes.

7 Future Work

At present there are very few software tools that support XML. To us XML properly within a educational environment we need software that can support XML: author a course; publish course material; capture and manage ongoing student/instructor interaction; store course material and allow easy retrieval methods for all types of users; and a user interface/browsers to view interact with the material. To date this XML support is limited however most software vendors have identified XML as a feature which will be added to forthcoming products. So to conclude when it comes to XML: "Watch this (Name)Space!".

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Totally Integrated Internet Courses

Richard Dwight Laws
Independent Study
Brigham Young University
United States
dwight_laws@byu.edu

Abstract: The notion of a totally integrated course is ambitious, particularly when that integration goes beyond course delivery to include grading, data entry, testing, feedback, and management of all aspects of the process. Imagine, if you will, a totally integrated Internet course (TIIC) in which a student can find the appropriate course, investigate it, register for it, receive all necessary materials, submit assignments, get grades and feedback, take the final exam, get a course grade, and receive a transcript in the mail without any human intervention (or for that matter without the university even knowing that the student had been there). This paper briefly explains how totally integrated Internet courses are delivered and managed at the Brigham Young University, Continuing Education, Department of Independent Study.

Introduction

Brigham Young University (BYU) is moving boldly into Internet courses. BYU has one of the largest home study programs in the nation, with over 500 courses and 42,000 enrollments. The Department of Independent Study manages these courses and plans to move many of them onto the Internet. Currently, BYU Independent Study offers over 70 totally integrated Internet courses (TIIC). There are problems associated with TIIC: they are not synchronous, and they are not social. However, TIIC have major strengths, which will be the subject of this paper.

Technology has given faculty new tools. However, those tools can quickly become burdensome if not properly used or designed. For example, the most prevalent form of distance courses that faculty have attempted is the use of e-mail for interaction with students in an attempt to be synchronous. However, faculty have been overwhelmed with demands on their time using this method and have, for the most part, been forced to discontinue using the tool for that express purpose. Those who continue to use e-mail have had to restrict enrollment to a manageable few. Michael P. Lambert (1999) says that "the brand of distance education that traditional educators are talking about for the most part is "synchronous" learning. . . . the concept of 'anytime' learning is not yet ascendant."

Another example is that faculty find their time almost consumed when they try to do their own course development using technology. They often do it well and like what they have created, but it just takes too much time to create, manage, update, and trouble-shoot. The problem is of nationwide significance and needs to be addressed in order for technology to fully benefit faculty.

TIIC address the problem of "anywhere, anytime" learning quite well. TIIC accommodate unlimited enrollment. They also reduce faculty burden and at the same time generate large amounts of faculty feedback asynchronously.

The Model

The system that drives BYU Independent Study's TIIC has the following components:

- Web course catalog
- automatic registration and credit card clearance
- delivery of course instruction
- assignment submission
- computer grading of all submissions
- faculty-designed computer feedback for all missed questions
- testing
- grade posting

• personalized Web report card accessibility for students
• and transcript distribution.

Faculty are paid up front for the development of the course and then receive a royalty per enrollment on the back end. They do not test or grade. Faculty involvement and time, after the course has been developed, is virtually zero. Therefore, there is no faculty burden nor enrollment limit.

As assignments come in and are graded, the data is stored for item analysis (ITEMAN). With a sufficient number of the same assignment from multiple students, ITEMAN then analyzes the data and determines which questions are weak. These questions are discarded and the faculty create new ones. By this process the courses and assessment become stronger through use.

When a student comes to BYU Independent Study's Web page (http://coned.byu.edu/is/) they are given the options of exploring all aspects of the TIIC. They can read through the course catalog, which includes all 500 courses. They can find information about diplomas, certificates, and how to succeed, and they can view frequently asked questions. They can learn about other free online services, such as grade checking, exam requests, and questions and interaction with the faculty for special circumstances. Finally, they can explore the listing of college, high school, and personal enrichment courses available to them—both paper and pencil and Internet courses.

When a student picks a course to inspect, they are taken to a screen that gives them additional information about the course, including an audio introduction to the faculty, instructions about navigating the course, course features, frequently asked questions, and course specific how-to-succeed instructions. They are given a sample test to learn how testing works on the Internet. They are shown a table of contents so they can know if the course teaches what they need. Finally, they are given the opportunity to enroll. If the student enrolls using a credit card, a password and a CD-ROM are immediately mailed to them. The CD is used in a seamless presentation of the video and audio part of the TIIC (this will be modified when streaming is sufficiently robust and dependable). The student is then able to open the main part of the course and proceed with the instruction and assignments.

There is also a powerful tool, located on the home page, that allows faculty access to a training segment which teaches them how to write Internet courses. This training guide was developed by professional instructional designers to help faculty move through the standard design steps for instructional delivery at a distance. (Incidentally, some on-campus faculty have discovered this faculty guide tool and are using it as a guide for developing the practicum for their in-class presentation.)

When the student has enrolled in the course and has received their password, they can open the course and begin studying. When they are ready to submit an assignment, they complete the questions and click on the Submit button. They immediately see a report of their grade, followed by a list of all questions they missed. These missed questions are then explained by feedback from the faculty-designed databank. This aspect of TIIC is the most popular element with the students. They love to have immediate, and complete, feedback for their work—something they don't often get even in a classroom. Many students who have enrolled in a TIIC have given the reason for the enrollment as being the feedback statements that they receive. The assignment grade is immediately transferred to the student's data bank and entered in their record. The student doesn't have to wait for answers through the mail and is therefore able to continue on with the next lesson if they choose. Immediate feedback also leads to higher completion rates among distance education students.

After all assignments have been graded and submitted, the student must find a proctor. The TIIC system will either forward the test to the proctor to be administered, or will send the proctor a code word which will open the test on the Internet. In the case of the Internet version, the test is graded online and entered immediately into the student record. The password for the test is then no longer valid. The TIIC system calculates the student's assignment grades, test grades, and overall course grade, and then sends a transcript by mail to the student.

None of the aforementioned steps require faculty input or interaction; therefore, the course does not add to faculty load and can accommodate unlimited enrollment.

Strengths/Weaknesses

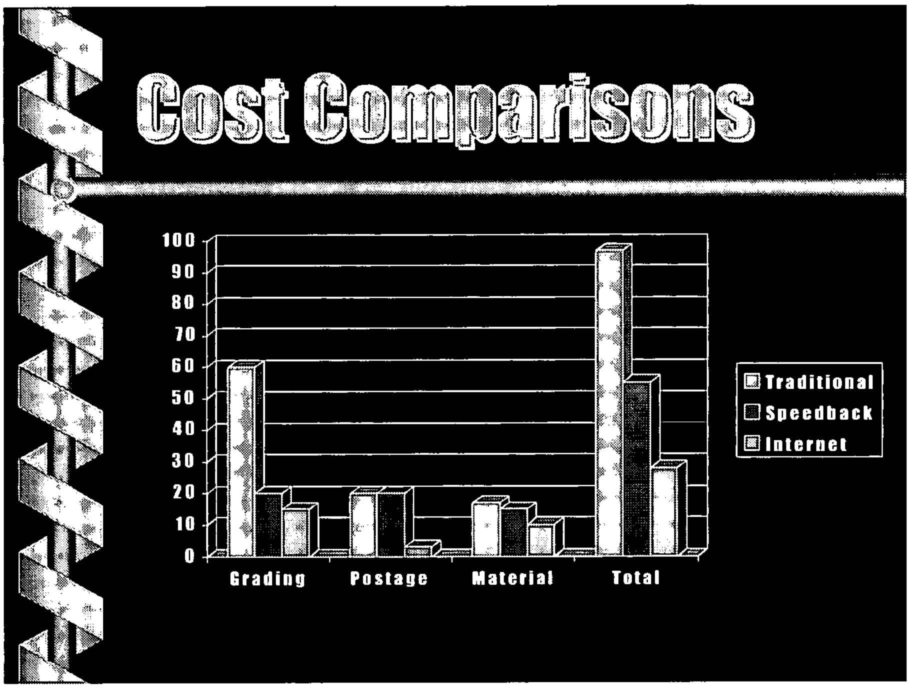
Some features of face-to-face learning (synchronous) are not currently available with technology. The attitude of many faculty is that this weakness makes distance delivery of courses unacceptable. However, face-to-face instruction, however strong it may be, is not necessarily a reality even in the classroom. Consider large classes where individuals never have access to the teacher. Also consider shy or less-aggressive students who seldom get interaction even in small classes. While lack of synchronous interaction may be perceived as a weakness, research has for years shown that distance education is not significantly less effective than on-campus classroom education. Thomas L. Russell compiled 248 research reports, summaries, and papers dating from 1928 to 1996 into a meta-analysis which he called the "No Significant Difference" phenomenon (http://teleeducation.nb.ca/nosignificantdifference/). Michael P. Lambert, executive director of Distance Education and Training Council, in Washington, D.C. (1999) said, "It is clear that distance education is here to stay. . . . Within the next three years, I predict that 3 out of 4 institutions of any significant size will be offering distance education courses." However, Lambert is well aware that "the faculty is the single biggest asset of any university and is at the same time the single biggest stumbling block to the rapid adoption of distance learning techniques on a massive scale." Lambert says that, "some faculties fear distance learning, seeing it as a threat to their jobs, to academic freedom and to sound learning." But Lambert predicts that "over time, most faculty will learn to love distance learning and come to see it as a personally liberating and empowering force, where they will become tutors and facilitators."

The TIIC system was designed to accommodate learning "anywhere, anytime." Its weaknesses are the weaknesses of current technology. Its strengths are the strengths of current technology. Included in those strengths is the ability to fashion excellent, educationally strong feedback statements to continue the learning process when students submit assignments. This feedback occurs for every student, even if there are 1,000 submissions. Such feedback and attention would be impossible for a single faculty member, or even a team of graders.

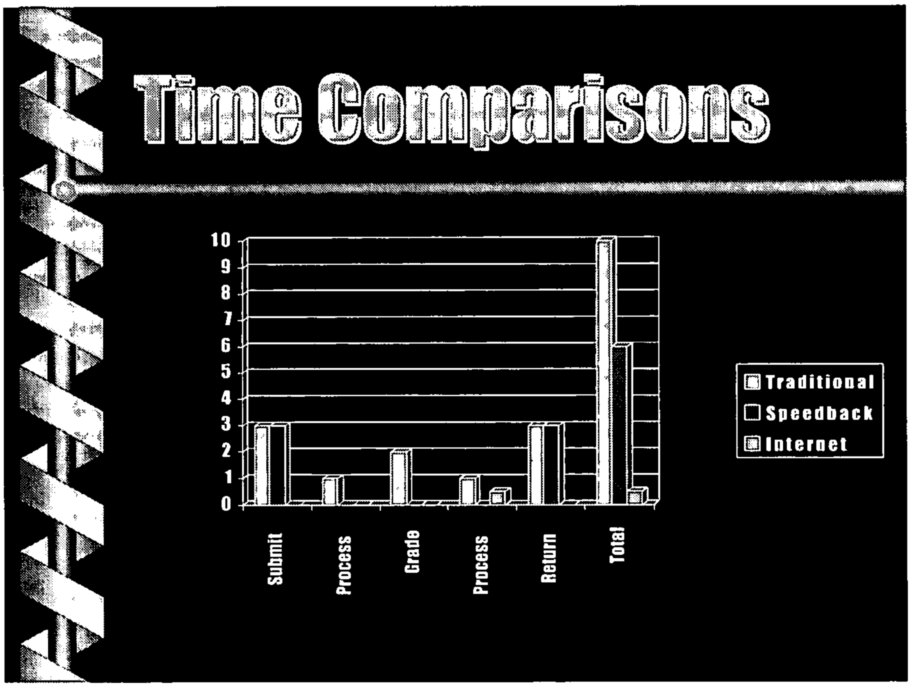
TIIC allows students their own place, their own space, and their own pace. TIIC is not subjective nor bias in its grading. Currently, assignments, quizzes, and tests are well-designed multiple-choice and other objective forms. It is anticipated that essay will soon be added to the system. It is also anticipated that computer adaptive testing (CAT) will soon become a part of the BYU TIIC system.

Management

While TIIC has strong educational and learning features it also has some distribution and management benefits. The system has reduced mail handling by 400,000 pieces per year even as enrollment has increased. Totally integrated Internet courses are easy to update and keep current (unlike printed inventory that must be used before reprinting). TIIC are easily formatted and changed to be attractive and easily navigated. The cost of a TIIC is only slightly more ($3,000 average) than developing traditional home study paper and pencil courses. However, TIIC pay themselves back as much as three times faster. The following graph shows the cost comparisons between three types of courses: traditional paper and pencil, computer-graded and managed paper and pencil (called Speedback), and Internet (TIIC).



The following graph shows the comparison of time a student must wait to get feedback from an assignment submission or test with traditional, Speedback, and TIIC courses.



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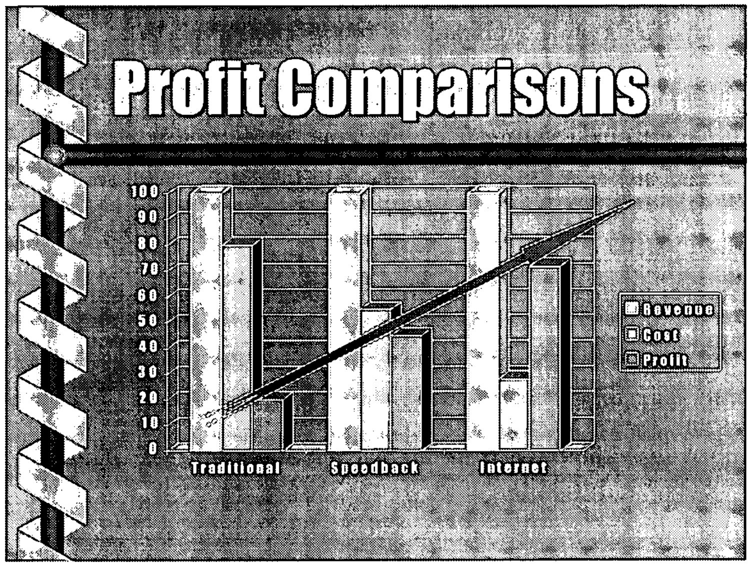
Finally, the profit comparisons of using the TIIC as compared to traditional or computer-managed courses is presented below. From a management or operational point of view, the difference is absolutely compelling. Because of the potential for education for profit, we see many corporations rushing to the totally integrated Internet courses market.



Conclusions

Distance educational is here to stay. Internet courses are here to stay. Totally integrated Internet courses can provide quality education, handle unlimited enrollments, and be profitable. The TIIC developed at BYU have had strong enrollments and excellent evaluative feedback from students. Although the TIIC has distracters, some of whom are very determined, the model has attributes and features that are very compelling. However, all technology-based instruction, such as TIIC, must maintain quality education as the foundation principal. At BYU, TIIC are built upon a foundation of instructional design principles, not media design principles.

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Multimedia Training and Remote Operating Laboratory: New Solutions for Electronic Measurements Courses

Nicoletta Sala
Academy of Architecture of Mendrisio
University of Italian Switzerland
Largo Bernasconi
CH 6850 Mendrisio - Switzerland
nsala @ arch.unisi.ch

Abstract: This paper describes an activity developed at the Department of Electronic (Dipartimento di Elettronica) - Politecnico of Torino in the field of computer based training in electronic instrumentation and measurements, where the author was a supervisor for educational process. Several modules have been developed, using multimedia technologies, to assist the students to acquire the fundamentals of the basic instrumentation. A client-server system has been designed in order to allow the students to operate on a remote laboratory for experimental training. The courseware includes lessons, exercises, and a training on virtual instruments which emulate actual instruments. The students can also carry out several real laboratory experiments without actually being in the laboratory, by using a client-server structure based on the Internet. The students have shown a favourable acceptance and have satisfactorily used the new tools. Demos of both the theoretical and practical part of the courses are available through the Internet.

Introduction

Education in fields such as electronic measurement requires students to gain a reasonable skill in using various kinds of instrumentation (Pisani et al. 1995). Such a skill cannot be achieved by theoretical lessons only, an intensive laboratory activity is also always required. This problem exists both for the first level and for qualifying courses (Sala 1999).

Basic instrumentation teaching is required for first level courses that are followed by a large number of students.

The cost of basic level instruments is often low, but large classrooms means large workbench availability and a massive and qualified assistance that is not easily found.

Qualifying courses are followed by few students so that the assistance problem is reduced, but the instrument cost in such a case is often rather high, thus preventing the possibility of arranging more than a few workbenches.

Some years ago the Department of Electronics, of Politecnico of Torino, was involved in activating traditional degree and diploma courses in several educational structures, throughout the Piedmont region. At that time requirements stemming from a large demand for education on experimental subjects and laboratory training had to be met with limited human and financial resources.

While trying to find a solution, it was realised that most of the time the students spent in the laboratories, especially for first level courses, was devoted to learning the operating functions and the use of the same basic instruments. It was therefore decided to invest time and resources to develop an alternative solution to the laboratory replication by using the new technologies offered by computer based multimedia courseware.

The goal was to allow the students to carry out a pre-training activity outside the laboratory and possibly at home; each student could thus individually adequate the learning rate to his own capabilities. After this pre-training phase, students who enter the laboratory require reduced assistance and less time to complete the training activity.

About six years ago several tutorial modules were developed that were organized like lectures, each being on a particular subject. Each module contains theoretical and functional concepts of a basic electronic instrument and allows for a simulated instrument exercising by providing a series of instrument simulators. By means of the realistic control panel of the virtual instrument the students practice under several operating conditions and situations. The pre-training problem is now becoming more important since the Department is getting involved in an education experiment named "Nettuno", in which the lectures are broadcast on TV or distributed on videocassettes, but students are still required to attend laboratories to achieve practical experience under the guidance of an instructor.

New modules were developed to tackle both the demand of laboratories distributed throughout the territory and requirements of the distance learning courses.

In addition, it was decided to explore the possibility of making a real instrument laboratory available for use at home. This work is devoted to reorganise our traditional educational approach, based on lectures and successive laboratory practice, using multimedia tools which combine two different learning phases:

- theoretical
- practice

in a single tutorial stage self-managed by the student.

Considerations

The actual curriculum of the engineering school include courses where the first practice electronic laboratory came before the first lecturers in which the students learn the theoretical and functional aspects of the instrumentation which deeper knowledge comes in a successive phase respect to the actual student requirements (Brofferio 1998).

It seemed to be necessary to provide the first course students by multimedia tools which allow them to use basic instrumentation in simple physics and first electronic circuit laboratories.

If these tools are organized with different study in depth it is possible to satisfy different needs of different kind of students (undergraduate school level or university education). On the basis of the previous consideration we have designed several didactic modules with the following purposes:

- to expose students to a comprehensive range of electronic instruments and basic measurements techniques;
- to allow students to give practice on the particular instrument whose front panel is simulated on the monitor and the behaviour is emulated by computer.

The learning phase can be managed by students (e.g., as homework) without involving the laboratory structures (Pisani et al. 1995; Sala 1999).

Course description

This multimedia course is structured on a set of lessons (modules) each containing a particular topic or instrument in form of a self – contained multimedia presentation.

Users may reference to selected parts of other lessons through hyperlinks, inserted in the text as hot words, mouse sensitive area and so on.

Differently from the other multimedia applications (e.g., traditional CD-ROM) our case is oriented to defined objectives of knowledge and it is based on a student model with a defined knowledge background, so it was decided to guide the students through a path, based on a structured didactic methodology, to reach the proposed educational goal (Bloom's taxonomy) (Pisani et al. 1995; Sala 1998).

For example a student of a first electric circuits course should be learn the oscilloscope or meter behaviour and should be able to handle them, while the post-graduate student should be interest more deeply to the internal circuitry and use these instruments in more sophisticated applications also involving uncertainty evaluation and so on (Pisani et al. 1995). Each module is divided into subjects (pages) at the same hierarchical level; each level contains a subset of other pages, placed at a lower levels.

Hyperlinks among pages have been studied to give continuity to learning trail (Sala 1999).

During software development, we put a particular care to make "friendly" the user interface (Sala 1997; Sala 1999) by designing:

- icons, with shape and image recall the linking function (e.g., an open door recalls the function to go out from the application);
- text-frame, giving brief information;
- hot words, which open one a few panel of explanations;
- a map, always available in the pages, which performs the "here we are" function and makes easy the navigating from page to page (the navigation inside a hypertext is important) (Calvi 1997);
- visual interface, which involves the choice of colours, background, bottom shape, type of font and so forth (Sala 1998).

Different media are involved e.g.:

- animation techniques, which are an efficient learning tool, when the teaching of a subjects would be difficult by a written description alone (e. g., the electron beam generation and control into a cathode ray tube);
- digitalized television camera images (e. g., to zoom an instrument inside);
- audio supports to stress some topic in a lesson (Figure 1).

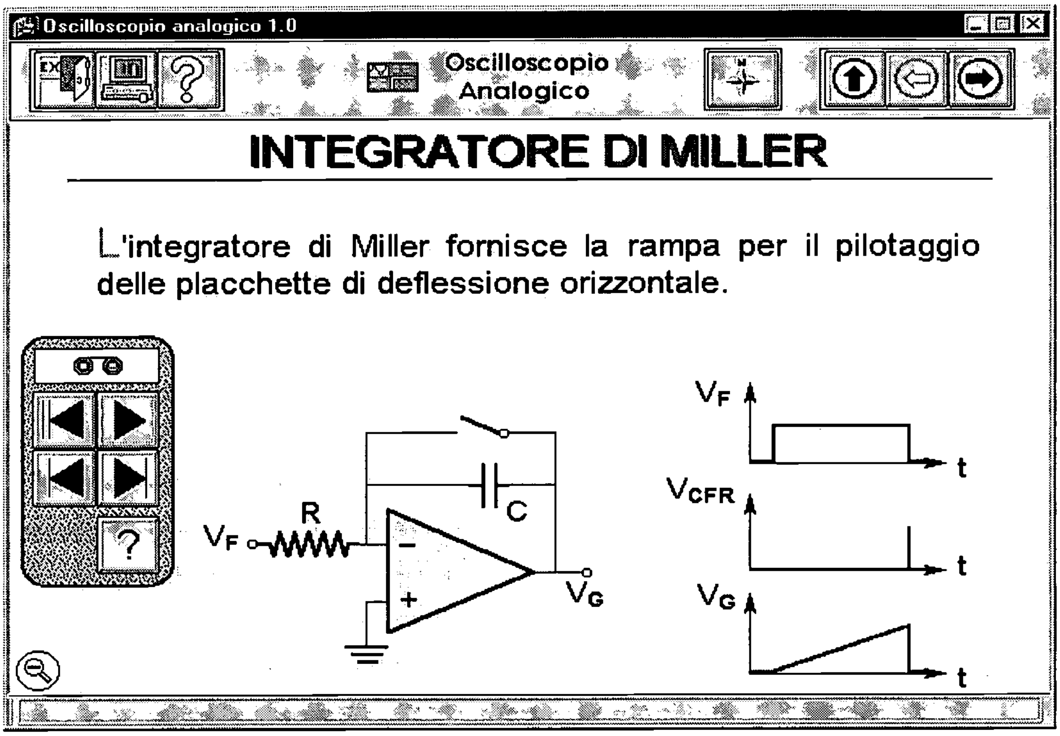

Figure 1 A page dedicated to the analog oscilloscope

Virtual instruments are implemented in the multimedia packages in order to allow simple simulations of the real instruments during the self-training phase. For example when learning the oscilloscope, the student has a virtual instrument panel available, where he can try to select the input signals and can evaluate the effects of the instrument setting on the display (Figure 2).

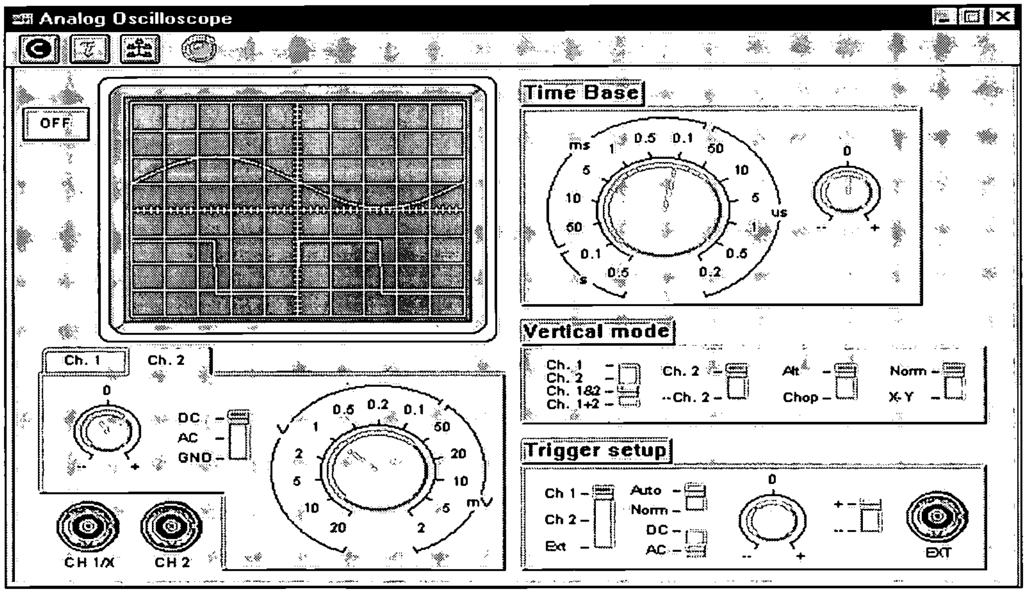

Figure 2 The virtual panel of the analog oscilloscope

Each lecture includes several tests to verify the level of the acquired knowledge on the educational objectives and lesson subjects.
The test results are stored into a database file, which can be processed by an external DBMS (Data Base Management System) program with the possibility to extract statistical indicators on the class by DBMS query.
Examinations include:

- puzzle, where students must rebuild an instrument block diagram (e.g., oscilloscope or electronic instrument) or measurement procedures.
- laboratory quizzes by multiple choices;
- simple projects, which could require few data processing. In all exercises, the data are randomly selected to always generate new projects entry points;

The students can adapt the learning rate to their time availability and cultural background. They can study the theory and then self-verify their knowledge level by solving practical exercises and answering a series of questions. The student only need an inexpensive personal computer with a multimedia extension, that is available in centralized structures of the university or possibly at home.
At present, several modules, concerning the basic laboratory instrumentation have been developed using Toolbook$^{(TM)}$, with the aid of several thesis student.
The subjects are:

- fundamentals of the analog oscilloscope, which includes practical exercises performed on a virtual instrument that emulates the main operating functions;
- fundamentals of the analog and digital voltmeters and their operating theory;
- the IEEE488 standard interface for programmable instrumentation.

Experimental training using hypermedia facilities

The courseware typology explained in the previous section well suits both traditional and innovative courses; however a further step is necessary in order to completely adapt it to the requirements of courses with an intensive experimental activity. Instrument behaviour knowledge is only one of the know-how that are required to carry out a measurement: performing a measurement is not so easy as it requires one to define measurement procedures, to use and correctly connect different instruments, and finally to process the experimental data.
This knowledge stock is traditionally achieved by performing practical activities in different subjects. Unfortunately, such an approach, which requires intensive laboratory attendance, cannot be followed in distance learning courses: a further step is necessary to break the time/distance constraint.
A possible solution could be attained by taking advantage of modern instrumentation, which is equipped with a standard computer interface and is remotely programmable
The idea is to design a laboratory that is simultaneously and remotely accessible to several students, who concurrently share the same instrumentation, but not necessarily the same experiment. The instrumentation and the other hardware resources are accessible in a sort of time sharing process, which is managed by a server and transparent to the user.
The virtual laboratory architecture is composed of two kinds of subsystems: the measurement Server and the measurement clients. In detail:

- The measurement Server is a computer located in the laboratory and directly connected to the programmable instrumentation. The Server program, that runs on the measurement Server accepts measurement requests from several clients, dispatches the commands to the instruments and sends the responses back to the clients.
- The measurement clients are computers running a program that enables the students to manage the experiments via suitable virtual panels and is able to contact the Server and display the measurement results.

Many solutions, based on proprietary or standard protocols, can be designed to obtain the connection between clients and the Server. The standard protocols that are based on the TCP/IP protocol suite using the highest possible protocol layer. Such a choice restricts the connection flexibility, but makes the developed system easily portable to different platforms and greatly simplifies the program development.
The connection among clients and Server is therefore established at the session level by employing the session and transport services which are provided by the computer operating systems: in the Windows environment the session level that is used is the Dynamic Data Exchange (DDE) used with the TCP transport (Figure 3).
In addition, to simplify further the development of the different experiments, an application layer program has been designed to handle the client-server communication. Such a program, which is called Measurement Server Access Facility (MSAF), is composed of a Server and a client part. The Server part, which runs on the

measurement Server, implements the queuing process on the incoming requests and keeps track of the different instrument configurations, that are required by the clients. The client part, which runs on each client, contains procedures to find out the Server, to establish the connection, to post the measurement request and to inform the client program about the expected delay before the measurement is actually performed.
By using the services provided by the MSAF, the experiment designer is only requested to deal with the measurement problem without being bothered by the underlining communication process.
The instruments are connected to the Server via an IEEE488.2 bus while the device under test is managed by a driving device which configures the experiment set-up using a series of switches.

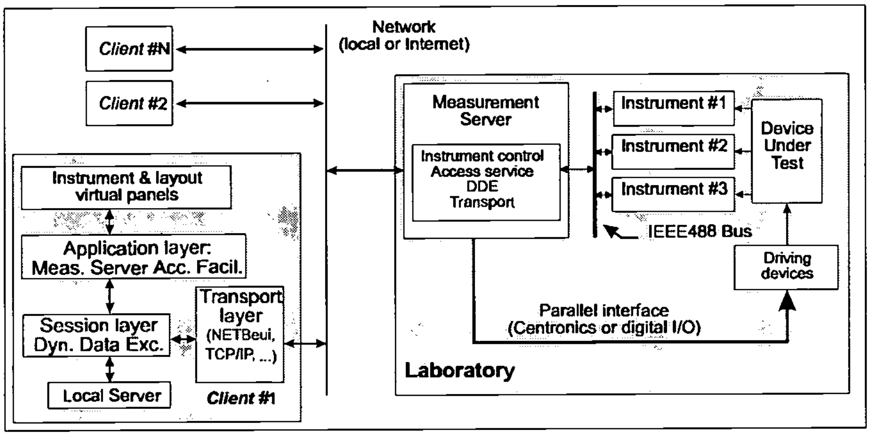

Figure 3 Client Server layout.

The driving device uses a multiplexed address/data scheme that allows a theoretical maximum of 65k switches to be used. The maximum number of concurrent experiments obviously depends on their complexity and layout and on the number of switches that are actually employed.
The experiment-specific part of the Measurement Server is restricted to a parser section which interprets the client requests and dispatches them to the instruments in a proper format. The experiment-specific part of the client is restricted to a virtual panel containing the instrument controls and switch set-up.
The Local Server is a program that runs on the client computer, and which allows a simulated version of the experiment to be carried out in the absence of a network connection between the client computer and the measurement Server. Such a simulation can be used for a "pre-training" on the program to reduce the network traffic.
All the software has been developed in the Visual Basic (TM) environment with the exception of a minor part written in Microsoft C++(TM). The software is released with a set up program that install all the required components in the client computer.
This architecture is capable of servicing about twenty clients within ten seconds which is quite a reasonable waiting time and is suitable for many different experiments. Up to now several experiments regarding both the use of fundamental instruments (oscilloscopes, DMM, ,...) and the basic measurement techniques (for example for measuring resistance, power, ..) have been designed.

Experimental results

About one hundred students (selected courses both in the "Nettuno" project) are involved in the experiment and the first response has been positive. A the moment using these facilities and in conventional degree courses
The testers were got used to the new teaching facility quickly and with great interest. In a short time they have been able to discover minor problems and inconsistencies in the proposed material and suggest valuable remedies. This feedback is quite useful both for teachers and students and allows a continuous quality improvement.
The effectiveness of the learning process of the course cannot yet be stated, since these innovations were only introduced last year, nevertheless the students' marks in the first tests show a positive trend.

Conclusions

Whether it is accepted or not, a fundamental shift is occurring in education as a result of increasing use of computers. Strange (1995) calls the shift as a cultural revolution in teaching and learning. The profound changes in the dissemination of information, the reorganization of information to include multimedia, and the implications of what it is to be a teacher in an era where teaching and learning increasingly means listening and watching as well as reading and writing have not been absorbed. The extent of the changes due to this cultural revolution vary depending on the district, school, and teacher (Rath, Rieck, and Wadsworth 1998).
The use of multimedia solutions in degree level courses has proved to be effective in several different fields. Courseware with important laboratory activities can also be tackled by adding an experimental section to the conventional theoretical approach.
Technical teachers can use these multimedia solutions to train new electronic instrumentation (Sala 1997). Integrating technology into teacher training programs is important because it appears that through the use of technology, teachers change the way they present instruction (Stuhlmann 1998).
Becker (1992) reported that teachers who had more experience with computers were more inclined to integrate the curriculum across subject areas and use computers as a tool for learning (Stuhlmann 1998).
The solution designed by the author for electronic measurement courses is an example of an integrated solution in which the theoretical part is made available through a hypermedia and the laboratory part can be carried out by accessing real instruments through a network connection.
Other modules are in aim to be developed concerning the impedance meters, the spectrum analyser and so on.

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Reading and Listening: Issues in the Use of Displayed Text and Recorded Speech in Educational Multimedia

Andy Reilly
Media Development Division
The Open University
United Kingdom
a.a.reilly@open.ac.uk

Note: This paper is based in part on work carried out by the author at Middlesex University, London, U.K.

Abstract: A tempting solution to the problem of too much text on screen is to present some of it via a spoken commentary. Questions then arise as to what is the best balance between displayed and spoken text, what pedagogic implications accompany the use of speech, how does spoken text differ from written text, and whether different types of user prefer information in different media. This study addresses these questions on the basis of tests carried out on an interactive project, and a review of the literature of educational technology. It shows that users express a clear preference for a mix of media, and students complete study tasks more quickly when information is available in sound and text. There is some evidence that preferences for one medium over another can be correlated to educational background and to sex. The potential value of further research in these areas is indicated.

Introduction

Research on the effectiveness of different media within multimedia learning materials has produced no firm evidence on the question of whether speech or text is more effective pedagogically, but users show a clear preference for a combination of text and speech (Alessi, 1991; Barron and Atkins, 1993; Shih and Alessi, 1996). This preference was shared by the volunteers who tested the project prepared as part of this study (Reilly *et al.*, 1997).

There is evidence to show that reading large amounts of continuous text from computer screens is tiresome (Dillon *et al.*, 1988; Gould *et al.*, 1987; Gould and Grischkowsky, 1984), and that tasks linked to reading are performed less efficiently when the text is on screen (O'Hara and Sellen, 1997). Open University students who were required to use a CD-ROM-based library of articles as part of a course in information technology reported a reluctance to read text from screen (Jones *et al.*, 1998). These findings might lead one to suppose that the use of recorded speech to reduce the density of screen text would be welcomed by students, but the evidence from software trials is not clear cut

As interactive media tools become more widely used in teaching there is a need to clarify their value as learning materials, and to determine guidelines for good practice in their design. This study suggests rules of thumb for the appropriate use of recorded speech and displayed text in educational multimedia.

The Renewable Energy Project

In 1998 I was part of a team of four researchers who produced an example of interactive learning material based on an Open University undergraduate course on Renewable Energy (Reilly *et al.*, 1998). Part of the project presented information in a mixture of screen text and audio voiceover. The project was tested in two phases by a total of eighteen subjects.

Educational Techniques and Technologies

The designers of educational multimedia attempt to create products that adopt a student-centred approach to learning. Like the face-to-face tutorial, teaching and learning tools should be adaptive, create a discourse between teacher and learner, encourage reflection, be interactive and enable the student to communicate their conception of what they have learned.

Where these characteristics are present, the teacher, the student and the media of instruction together form a 'conversational framework', which 'serves both to clarify the second-order character of academic learning, and to define its essential components' (Laurillard, 1993, p. 102). This conversational framework allows the student to reflect upon the subject taught, and convey to the teacher his or her understanding. The teacher can adapt the teaching approach in the light of the student's description of their understanding, and the student can amend their conception in the light of the teacher's response. In this way a discourse is established through which the process of learning moves forward.

No artificial presentation can entirely substitute for a one-to-one tutorial dialogue between a teacher and student. But the opportunity to use recorded speech in the context of an interactive presentation can bring something of the quality of real dialogue to a piece of tutorial software.

Our project testing, and the results of research cited in the next section, show that users respond favourably to teaching software that includes recorded speech.

Relative Advantages of Text and Speech

Alessi (1991), writing in the context of the instructional use of interactive video, has proposed a number categories for classifying the relative advantages of text and speech, including: (a) realism, (b) dual modality, (c) learner controllability, and (d) learner characteristics.

Realism

Realism risks overloading students with excessive detail. However, "The use of human voice in the delivery of instruction appears to be a case where increased fidelity does not correspond to increased detail." (Shih and Alessi, 1996: p. 206)

Dual Modality

Do two channels of instruction, textual and auditory, produce a better learning outcome than one channel alone?

Barron and Atkins observe that students with higher verbal skills do not gain significantly from the addition of audio, but that students with lower literacy skills may register better performance with additional audio.

Where both auditory and visual media are used in an instructional product there is some evidence to suggest how they can be synchronised to best effect. Baggett (1984) conducted a series of tests in which students were asked to study the components of an assembly kit. The parts were shown using a videotape sequence, but they were only named in an audio voiceover. Several presentations were made to several different sets of students. Some heard the commentary slightly ahead of the visual information, some saw both video and audio synchronously, and some saw presentations in which the audio lagged behind the video by up to 21 seconds.

The results showed that when the audio preceded the video information much of the audio commentary was forgotten. The best recall was registered by the groups who experienced both audio and video simultaneously or with a 7 second delay. Delays greater than 7 seconds led to success rates 80% worse than the best scores.

Controllability

A weakness of audio instruction is that it is transient. Romiszowski (1988) reports on research carried out at the BBC that showed that only 28% of the content of a five-minute radio programme was retained by the average listener. University graduates took in 48%, while recent school leavers retained only 21%. One of the advantages of text is that it can be rehearsed. Text can also be read at the reader's ideal pace.

For audio instruction to be similarly useable it must be controllable, at least to the extent that users can listen to short sections at a time, and pause and replay them at will. This was borne out by the testing we carried out on our project (Reilly *et al.*, 1997). Our test subjects criticised our first prototype because the audio sequences were too long, and could only be replayed from the beginning. In the second version the sound files were segmented, and each segment could be selected and played separately.

Learner Characteristics

As noted above, variations in literacy skills will have an effect on the suitability of sound or text as the medium of instruction. Other learner characteristics may also play a part in the way in which media are perceived by users. The results of our project testing (Reilly *et al.*, 1997) showed a difference between men and women in the acceptability of spoken commentary.

Our study also suggested that educational background may have an influence on how different media are perceived by users. Of eighteen subjects who worked through our project over the course of two rounds of testing, four were graduates, one was an undergraduate and thirteen were non-graduates. Two of the graduates and the undergraduate expressed a preference for reading over listening to a spoken commentary. All the rest reported that they found the combination of text and commentary helpful. Age variations may also play a part in how different media are accepted and used.

Balancing the Pros and Cons

This analysis suggests that a choice can be made on the basis of the nature of the content, the literacy skills of the target users, and the constraints imposed by the requirements of production and updating. A simple rule of thumb emerges: the more abstract the content and the more literate the users, the more text one would use; the more concrete the content and the less literate the users, the more speech one would use

Design considerations based on these characteristics alone are insufficient. Before this rule of thumb can be used with any confidence it is necessary to examine evidence for its applicability.

Effects on Learning

When Shih and Alessi (1996) offered a group of test subjects a choice of text only, voice only, and a combination of text and voice, 82% showed a strong preference for the combination of text and voice.

Their results are consistent with those of Barron and Atkins (1993) who found no statistical difference in achievement between a text-based tutorial program and a combined audio/text program, although the combined presentation was completed by subjects significantly more quickly.

This observation, that a combination of media leads to a quicker assimilation of information, bears out the results of a number of studies cited by Bagui (1998). Kulik, Bangert and Williams (1983) recorded a substantial cut in study time for a group of secondary school students who followed a computer-based instruction session, compared to another group who were taught the same content in a conventional classroom lesson.

User Preferences

The results of the studies referred to above were more clear cut in showing the preferences of users for types of presentation. When my colleagues and I tested our project (Reilly *et al.* 1997) we found a similar marked preference for combined speech and sound. Our project design included a series of audio/text screen sequences in which a spoken commentary was summarised by bullet points that appeared sequentially on screen. In some sequences the bullet points were verbatim quotes from the commentary. In others they were paraphrases. In all cases the displayed summary appeared on screen slightly ahead of the corresponding commentary. None of the test subjects commented on the difference between the verbatim summaries and the paraphrased ones. This difference either went unnoticed, or was not considered significant.

The sequence of text first, commentary following but overlapping was noticed. Half the subjects suggested that separating the text and speech would be better that having the audio running while the text was being read. "I would prefer the audio sound to come either before or after the bullet points rather than together as I found it distracting." (Quote from test subject (Reilly *et al.*, 1997: p. 3).)

Dual modality in this context was not seen to be helpful. The subjects clearly preferred to experience a single channel of communication.

Most of this group said they would prefer to read the summary before they heard the commentary - although one subject suggested the opposite approach.

Other potential variables that deserve further study include whether personality type, sex or age affect the acceptance of different media types. The test subject who said he would prefer text only commented that he wanted greater control over the pacing of the presentation.

Control was a key element in all the test subjects' responses. The spoken commentary, while generally well received, was perceived to be difficult to select and rehearse. These difficulties are not intrinsic to an audio presentation, but were a consequence of the way in which we designed our use of audio. In our revisions of the project we addressed this issue by dividing the audio files into smaller chunks and allowing them to be individually selected, played, paused and replayed.

The Combination of Text and Speech: the Value of Redundancy

The clear preference expressed by users in all the studies cited for a combination of text and speech suggests the question: 'What merit is there in presenting the same information in two forms?' Donald Norman (1993) lists some advantages for redundant visual information. He describes the case of a business presentation where it is not uncommon for the speaker to use slides that provide no new information, but which essentially repeat what is being said. These slides offer the audience a shared workspace; they afford co-operative work; they represent a permanent memory; they increase available memory; they aid perceptual processing; and they offer an alternative channel of communication for those people who prefer auditory information.

Multimedia presentations extend these advantages. Here time is under the control of the users, not the lecturer. Control is also in the hands of the user if they are able to reselect and replay information. Perceptual processing is afforded not only by the spatial arrangement of ideas on a single screen, but also by the accessibility of other screens. Individual differences can be catered for, not only in offering choices between spoken and displayed text, but also by offering information in other media such as video or animations. The wider the choice of media types, the more a wide range of users will feel accommodated by the presentation.

Greater redundancy provides the opportunity for users to tailor a presentation to their tastes. But the danger of excessive redundancy is that users may feel uncomfortable because they do not have a feel for how much content they should access to gain an adequate understanding. The initial reaction of many students to an Open University CD-ROM that contained a library of reference material was to try to read as much of the content as possible in case they inadvertently missed some important detail (Jones *et al.*, 1998). Only when they had become skilled in carrying out focused searches of the material were they reassured about how much material it was necessary to view.

Successful use of interactive material in which there is a significant degree of redundancy depends upon users acquiring the skills, and the tools, to be selective and to evaluate the relevance of the content they retrieve.

Spoken and Written English

An important aspect of the design of a multimedia product that uses both spoken and displayed text is a recognition of the differences between spoken and written English. The two forms of language are distinct. Written English conforms to rules of style and syntax which do not apply to spoken English. When a speaker uses the style of written English he appears either to be reading or reciting a document, or else he comes across to his listeners as stilted and excessively formal. These characteristics are often interpreted as insincerity (Jay and Jay, 1996).

When a reader reads a text, they can pause over aspects that are not immediately clear. When listening this is more difficult. Although it is possible to provide users with the option to pause an audio sequence, if your user has to pause frequently they will find your product tiresome to use. There are certain key features of well prepared spoken English that help to avoid the need to pause.

Abstract nouns should be avoided. These can cause listeners to struggle with the speaker's meaning.

Spoken English should use short words and sentences, and should avoid abbreviations, lots of numbers, and unfamiliar names (Garrand, 1997). Numbers are particularly difficult to absorb and remember from speech.

The active rather than the passive voice should be used. For example, 'Solar energy provides ten per cent of Greece's winter heating', is better than 'Ten per cent of Greece's winter heating is provided by solar energy.'

Specialist terminology should only be used for specialist audiences, or when its use is specifically explained.

Word and phrase order are important. Whereas the rules of written style suggest that one should avoid placing parenthetical phrases after the main verb, this style is difficult for listeners to follow. Similarly, with a document readers can jump ahead to see how much they still have to read. Headings and paragraphs can provide signposting and orientation. With spoken English it is necessary to build in signposting phrases, such as "Well, that's the basic question, so now we'll take a more detailed look at viable options." (Jay and Jay, 1996: p. 50).

Conclusions

The desire to create a conversational framework or dialogue within which to situate learning has implications for the design of learning tools. Interactivity helps to create this framework, and the use of speech in addition to text adds an element of realism to the media mix.

This dual modality of verbal and textual communication presents advantages in giving learners an aid to processing and remembering information. It offers users choice, and an element of control over the type of learning medium and the pace of study. Combining speech and displayed text is welcomed by users and encourages efficient study.

In examining learning outcomes it will be necessary to classify users by level of literacy, previous educational attainment, age and sex. The evidence from our project testing suggests that the way in which information in different media is received may depend to some extent on these variables. The issue may be complicated by age. Sex also seems to be a factor, with men being less receptive to a spoken commentary than women.

If such differences prove to be significant, the value of media redundancy will become clearer. Redundancy provides the opportunity for users to tailor a presentation to their tastes, and enables a piece of software to cater for a range of users.

Our study also revealed that to be acceptable a spoken commentary must be controllable. It should be available in short discrete parts, each of which can be paused and replayed, and each of which can be selected and played individually (although they may need to run in a particular sequence when first heard).

While media redundancy is welcomed by users, media overlap can be confusing. Users should be given the opportunity to read and listen separately, and not be forced by the design to do both at the same time.

In scripting passages of recorded speech, the scriptwriter must be aware of the difference between spoken and written language. Spoken language follows different rules of syntax from those of written language, and while vocabulary need not differ, the excessive use of specialised vocabulary in speech runs the risk of confusing listeners, even when they are familiar with it.

Further empirical studies and more widespread experience in the use of multimedia in higher education will improve the base of evidence on which future design strategies can be founded. In the meantime, the study described here and the evidence available from the literature suggest that presenting information in complementary media, with careful thought given to the balance, synchronisation, overlap and redundancy of media forms, will assist learners in shaping their own learning strategies and give them greater control over their learning.

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Incorporating the Internet in the Classroom

By John F. Bennett Marketing Professor, Stephens College, Columbia, MO. USA

Introduction

Much attention has been devoted in recent years to the development of Internet courses that are targeted to distance learning students. This follows the movement towards the establishment of virtual campuses by many business schools including such prestigious institutions as Duke, which recently graduated its first class in its Global EMBA program, and MIT, which offered its first credit course in accounting over the World Wide Web in fall 1997. While this trend will continue to grow the fact remains that the majority of business courses continue to be offered in a traditional classroom setting. However, while most business courses are being offered in a traditional classroom, they are certainly not being offered in a conventional manner as more business schools have exhorted their faculty to incorporate Internet technologies in their courses. Unfortunately, those faculty desiring or being exhorted to move toward technology-mediated instruction are not always given sufficient guidance on how this should be done. Consequently, many respond by either disdaining technology and holding steadfastly to the status quo or, worse, using a haphazard approach in incorporating technology in their teaching without any real understanding of its pedagogical value. The purpose of this paper is to provide direction to those of want to improve the quality of their on-campus courses by incorporating Internet technology in their teaching.

Rationale for Using Internet Technologies in the Classroom

While there are several Internet technologies that can be used to support instruction, the ones that seem to be generating the greatest interest among educators are email, electronic discussion groups and the World Wide Web. This is hardly surprising when one considers the many benefits these tools offer the classroom teacher. One such benefit is improved communication. Electronic discussion groups, for example, can serve to enhance and extend interactions between students and between students and their instructors (Karayan and Crowe, 1997). Students in a class can share an insight or opinion at any time of day or night rather than having to wait until the next class meeting. It also provides a means of participation for those students who are reluctant to participate in traditional class discussions (Partee, 1996). It is often easier for these students to discuss values and personal concerns in writing than orally, since inadvertent or ambiguous nonverbal signals are not so dominant (Chickering and Ehrmann, 1996). More vocal or impetuous students can also benefit from the increased reflection necessitated by putting thoughts into words for an on-line discussion.

Using email and electronic discussion groups also facilitate such activities as study groups, collaborative learning, group problem solving and discussion of assignments. Students no longer have to worry about finding time on their often busy schedules to have a face to face meeting with their peers. Increasing opportunities for students to work together increases their involvement in learning. As Chickering and Ehrman (1996) note, being able to work collaboratively with one's peers improves thinking and deepens understanding. It also allows students a more real-world experience that contributes to an enhanced educational setting (Hunter, 1990).

Use of these Internet tools can also encourage active learning. Very little learning occurs when students simply listen to a teacher and memorize a set of lecture notes. They must talk about what they are learning, write reflectively about it, relate it to some past experience, and apply it to their daily lives (Chickering and Ehrmann, 1996). In other words, they must become active as opposed to passive learners. If structured into a class in a purposeful, pedagogically-sound manner, listservs can improve learning (Everett and Ahern, 1994). This is supported in one study that found that slightly more that 40% of students indicated that their learning had either increased or increased a lot from using e-mail (Sandell, Stewart, and Stewart, 1996).

Requiring students to communicate via e-mail has been found to improve their ability to write coherently (Kàrayan and Crowe, 1997). In the process of contributing to the on-line discussion, students are using a mode of expression that is a form of writing: composing their ideas at the keyboard, editing their comments, and then "publishing" their comments to the list. The list subscribers then provide feedback, commenting on the quality of the message, objecting to the ideas expressed, asking for clarification, and so on. This public nature of the writing and public exchange of ideas causes students to take their work more seriously. They make a greater effort to ensure that their messages are clearly conveyed and that their claims are adequately substantiated. They also begin to take pride in writing well, especially when others commend them on what they have written. By participating in an public e-mail forum, students learn how to think through ideas, how to anticipate and respond to objections, and how to express themselves with clarity and power all of which improves the quality of the responses to the discussion (Karayan and Crowe, 1997).

Expanding the boundaries of the classroom to include individuals and noted scholars from other parts of the world is made possible through the use of email and electronic discussion groups. This adds an intercultural dimension to a class that might otherwise not be there and expands the diversity of thought being shared in class discussions (Bailey, 1994).

Use of these Internet technologies also makes it easier to appeal to a greater number of learning styles. Visual learners, for example, can access explanatory diagrams or animations to enhance meaning, more active or inquisitive learners can "read around" their subject by means of hypertext links and so on. In addition, the different representations of information (sound, text, video, graphics, etc.) made possible through Web technology, greatly increase the richness and appeal of the learning environment. They present the learner with a much broader coverage of material and more ways to encode and remember that information.. One study conducted by the Center for Innovations in Engineering Education at Vanderbilt University, found that learners using an electronic laboratory simulator on their own time in lieu of physical labs were able to solve problems on physical equipment as fast or faster than those who took physical labs. In addition, the written lab tests were found to be equivalent between the two groups (Campbell, 1998).

Applying Internet Technologies in the Classroom

While the decision about whether or not to use Internet technology in the classroom can be difficult, it is much easier than trying to decide on the specific Internet technologies to use and how they should be applied in the classroom. This is due to the fact that teachers do not all subscribe to the same teaching philosophy or style. Rather, each brings to the classroom his/her own unique teaching style that calls for a specific set of instructional methods and technologies - including Internet technologies - that would not be appropriate for any other teaching style. Therefore, the Internet technologies and applications cited in this paper are meant only to provide the reader with a greater appreciation and understanding of the pedagogical value of the Internet. Whether any of these technologies or their applications would be appropriate for the reader to use would, again, depend on his/her preferred teaching style.

In the remainder of this paper, I will discuss the Internet technologies I currently use in my undergraduate marketing courses, how these technologies are being applied, and the effectiveness of these technologies in enhancing the quality of my courses.

When I became convinced that the Internet had the potential to enhance the quality of my marketing courses and began to incorporate it in my teaching, I was immediately faced with a dilemma: which Internet technologies do I use? There are many different technologies that can be applied in the classroom which is both an advantage and a disadvantage. It is an advantage because it gives the instructor many options to choose from. Everything from email to chat rooms to video conferencing over the Web. However, it is also a disadvantage in that, it makes the task of selecting the most appropriate technologies, especially for someone who has little or no experience using these technologies in the classroom, a most challenging one. To facilitate the task of identifying the most appropriate set of Internet technologies to use in my courses, I applied the following evaluative criteria: 1. does the technology support any of my instructional goals and objectives? , 2. is it technology that I would be comfortable using?, and 3. are there sufficient institutional resources to support the technology? After considering these criteria, I decided to use three Internet technologies in my courses: email, listservs, and the World Wide Web. These were the Internet technologies I was most familiar with and the ones that I believed would best support my instructional goals and objectives. I was also confident that the institution could provide me with the additional resources I would need to utilize these technologies in the classroom.

After identifying the Internet technologies to use in my courses, it was necessary to determine how they should be applied to meet the following instructional objectives: 1. improve communication to, from and among students, 2. facilitate access to course materials, 2. introduce students to the potential of the Internet as an information resource and encourage them to use it as a research tool, 3. increase the interaction between students and marketing practitioners, 4. expand coverage of topical issues in marketing, 5. appeal to a greater variety of learning styles, and 6. facilitate classroom management. The specific strategies used to meet these instructional objectives are detailed in the next section.

Improving Communication

In order to improve communication to, from and among students several strategies were used. During the first week of classes, each student was required to obtain an email account and to subscribe to the class list. This list was used throughout the semester to notify students of scheduling changes, to distribute pertinent news reports from on-line publications, to post a weekly list of learning objectives, and to provide any needed clarification of lecture or reading material. Also, on a weekly basis, the students are required to post to the list responses to questions from assigned readings and to respond to at least two of the postings of their peers. This is meant to augment in-class discussions and provide the students with a communal meeting area where they can share ideas, ask each other questions, seek advice, etc. As noted earlier in this paper, providing students with the opportunity to participate in on-line discussions provides a means of participation for those students who are reluctant to participate in traditional class discussions, promotes active learning and improves students' ability to write coherently.

To encourage students to communicate with each other on-line, a class list with links to students' email addresses was placed on each course's Web site. If a student wanted to send an email message to another student, he/she only had to access the Web page with the class list rather than search for that student's email address. To encourage students to communicate with me on-line, a link to my email address was provided on all on-line documents like the course syllabus, lecture notes, class assignments, and review exams. For those students who wanted to communicate without identifying themselves - most likely to occur when the student has a critical comment to make and fears retribution if anonymity isn't guaranteed - an evaluation form was made available on each course's Web site that could be submitted anonymously.

To Facilitate Access To Course Materials And Introduce Students To The Potential Of The Internet As An Information Resource And Encourage Them To Use It As A Research Tool.

For each course, a Web site was created to facilitate access to all course materials such as the course syllabus, class assignments, review exams, assignment schedule, Powerpoint presentations and lecture notes. To introduce students to the potential of the Internet as an information source and to encourage them to use it as a research tool, links to external resources were provided in many of these Web documents. For example, the lecture notes have links to Web sites containing additional information on topics covered in the notes, the syllabus has links to the on-line publications used in the course such as Business Week, the Wall Street Journal, and Advertising Age, and the class assignments have links to Web sites with information pertinent to the assignments. In addition, a directory of marketing-related Web sites is maintained on each course's Web site as is a directory of Web sites offering guides designed to be helpful to students. These would include guides on writing a research paper, developing a marketing plan, creating an advertising campaign, giving a formal presentation, etc. Also, students are encouraged to seek out Web sites related to the course and post a link to the site on the class list.

To Increase Interaction Between Students And Marketing Practitioners.

In order to help bridge the gap between the classroom and the "real" world, 4 - 6 marketing practitioners with varied types of expertise are invited to participate in on-line discussions with my students. The class submits a list of 5 - 7 questions via email to the marketing practitioner who then posts his/her responses to the class list. The students are then given up to a week to ask the marketing practitioner any follow up questions they may have. The postings of the marketing practitioners are archived and used in future classes.

Expand Coverage Of Topical Issues In Marketing.

To keep the course content focused on topical issues, a summary of marketing news stories from on-line journals, magazines, and newspapers are emailed to the class list on a weekly basis. Students are expected to read these weekly news reports and be prepared to discuss them in class. In addition, on a biweekly basis students are required to participate in an on-line discussion of a current news story related to marketing that has been reported in the Wall Street Journal (which every student is required to read for class). Finally, on each course's Web site, a comprehensive directory of marketing-related Web sites is made available so that students can learn about current events in the different areas of marketing studied in class. To encourage students to use this directory, a summary of the marketing topics discussed at each Web site is provided as is a link to the site. Students who visit these sites and share with the class what they read, can earn extra credit points.

Appeal To A Greater Variety Of Learning Styles

To appeal to the variety of learning styles represented in a typical class, various strategies were used. For visual learners, explanatory diagrams were made available on the course Web site. The diagrams were linked to the topics in the on-line class notes that they were associated with. For inquisitive learners, external links were provided in the on-line class notes and, as noted earlier, a directory of marketing-related Web sites was made available to increase both the range and depth of information available. Finally, the on-line notes were comprehensive (average length was 10 pages) in order to get students, especially auditory learners, to not only pay greater attention to what was being discussed in class but to increase their degree of participation in class discussions.

Facilitate Classroom Management

As noted earlier, all course materials - course syllabus, lecture notes, course assignments, assignment schedule, and review exams - are made available on the course Web site. Besides providing students with greater and immediate access to course materials, this has the added advantage of eliminating the time and expense of making and distributing hard copies. Other time saving measures include the requirement that all homework assignments be submitted electronically so that they can be graded and returned via email, an FAQ section on the course Web site with answers to frequently asked questions about class policies, grading, assignments, etc., and the submission of student progress reports via email.

Student Reactions

Each semester, students in my marketing courses are surveyed to assess their reactions to using the Internet in the classroom. A total of 149 students have been surveyed over a two year time period and asked to comment of the use of electronic discussion group assignments, on-line resources such as lecture notes and review exams, and on-line discussions with marketing practitioners. A summary of the survey results follows.

Electronic Discussion Group Assignments

The students noted several benefits and problems with using electronic discussion group assignments. The most frequently cited problem with using EDG assignments was inconvenient access to computers with Internet connections. Students also indicated that they felt overwhelmed by the number of e-mail messages they were receiving each week. This was particularly true among those students who were on several class lists. Some students noted that there was too little discussion of the pedagogical benefits of electronic discussion groups. Consequently, at the beginning of the semester they failed to understand why in-class discussions were being supplemented with e-mail discussions. It was only after participating in the electronic discussions for a few weeks that the students began to understand their value. Finally, some students lacked experience using e-mail and expressed a fear of this technology. These students noted that their participation in e-mail discussions would have been greater if they had received some remedial assistance with the technology being used.

One benefit mentioned by several of the students was that electronic discussions provided a convenient means of interacting with peers as well as the instructor. They appreciated being able to send and reply to an e-mail message at a time of their choosing. Students also noted that it was easier to collaborate with their peers on group projects. The frustrations caused by trying to arrange convenient meeting times for a group of students to physically meet and work on a project are largely eliminated with electronic discussions groups.

A few of the students commented that they were more comfortable with written rather than oral discourse. They stated that they felt more willing to make provocative assertions during e-mail discussions and to challenge the views of their peers and the instructor. In short, they felt liberated by this new medium.

Some of the students believed that they had a much better understanding of the discussion topics as a result of being required to read and respond to their peers' postings to the list. They appreciated the fact that in electronic discussions they can take more time and reflect longer before responding.

On-Line Resources

Students found the availability of lecture notes, Powerpoint presentations, and review tests on the course Web site to be very beneficial. Many students commented that the on-line notes and Powerpoint presentations allowed them to focus less on note taking and more on participating in class discussions, and improved their comprehension of the lecture/reading material. The placement of links to external resources in the on-line notes was very much appreciated by the students because they made it convenient for them to gather additional information on the concepts being studied.

The on-line review tests were favorably perceived because they provided students an opportunity to conveniently assess their comprehension of the reading/lecture material at any time. The students also indicated that they were encouraged to seek assistance by being provided with several links to the instructor's email address on each on-line review test. Finally, students responded that they found the on-line review tests more helpful than conventional review tests since the questions were linked back to the sections of class notes that they were drawn from. This made it much easier for the students to find detailed explanations for the answers given.

On-Line Guest "Speakers"

The opportunity to engage in on-line discussions with marketing practitioners was favorably perceived by the students. Many of the students indicated that their interest and understanding of the subject matter was greatly enhanced by being able to engage in an on-line discourse with marketers about a wide variety of topics. Students also commented that these on-line discussions gave them a much greater appreciation of the increasingly important role that Internet technologies now assume in the workplace. This was reinforced by many of the guest speakers who often discussed how they utilized the Internet in their jobs. Finally, some of the students thought the on-line guest speakers were much more informative than in-class guest speakers. This is due to the fact that each guest speaker had agreed to hold an on-line discussion with students over a period of several days rather than a single class period as is typically the case when a speaker comes to the classroom.

Conclusions

Based on student feedback and my own observations and experiences over the past two years, I believe the instructional objectives established for the Internet technologies I have incorporated in my courses were largely achieved. For others considering using the Internet technologies in their courses, I offer the following recommendations:

1) Consider only those technologies able to support the teaching and learning strategies being used. Using technology for primarily comestic purposes - perhaps to give one the image of being on the "cutting edge" - will almost certainly lead to a degradation rather than a genuine enhancement of the quality of the course.

2) Determine the availability of the resources and support services needed for the technology being considered. Be especially mindful of the difficulty students may have getting access to computers connected to the Internet. Ideally, all students would have their own computers that would provide access to the Internet. However, it is more realistic to assume that at least a few students will be wholly dependent on the institution's computer resources. Should access to computers on campus be a problem for students, the use of Internet technologies may need to be limited, perhaps significantly, until access improves.

3) Assess whether there are differences in the students' levels of comfort and understanding of the technology being used. If differences are found, provide whatever assistance is needed to eliminate or minimize them. Otherwise, some of the students may become frustrated and simply refuse to use the technology.

4) Consider making computer literacy a prerequisite for the course. Doing so will help eliminate the need for remedial computer training.

5) On a regular basis, measure the extent to which the technologies are meeting their intended objectives and expect to have to make several changes before coming up with the optimal mix of technologies to support your style of teaching.

6) Make sure that students understand the pedagogical benefits of the Internet technologies being used in the course. Doing so can lessen the resistance students may have toward using these technologies.

7) Finally, expect the unexpected. Web links may be rendered invalid, disk drives may crash, pesky viruses may infect your network, etc. However, despite the occasional problems they may cause, Internet technologies have the potential to greatly enhance the quality of the education you provide your students.

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The Millennium Satellite Project: A Case Study.

Gill Nicholls
School of Educational Studies
University of Surrey, Guildford Surrey. GU2 5XH
G.Nicholls@surrey.ac.uk

Abstract: This paper will report on the development and implementation of the Millennium Satellite Project (MSP) in five secondary schools in England. It will show how the project was constructed, the roles schools, teachers and pupils had in the development of teaching material and learning experiences. The pilot stage of the research is considered here as a case study. MSP was initially constructed to motivate schools to use the Internet in science teaching, and help promote one particular aspect of the Science National Curriculum in England and Wales; that of Earth and Space. It was intended that pupils would be able to access data from the satellite through a web-site on the Internet. A major objective of the project was to establish the potential of using satellite science within the National Curriculum, and as a means of motivating students towards Science. The project is a collaborative venture between the University of Surrey, Roehampton Institute and MSCL.

Introduction

The use of information and communication technology (ICT) in subject teaching in England and Wales has become a statutory aspect of a teacher's life. Teachers have to have knowledge, understanding and skills in using ICT in subject teaching. Within this remit teachers should encourage pupils to become familiar with ICT and positive users of it, ensure that all pupils have opportunities to use ICT. (adapted from Circular 4/98) This same document talks of ICT being considered as more than just another teaching tool. Its potential for improving the quality and standards of pupils' education is quoted as being significant. (pg.1, Circular 4/98). Against this background the MSP was trialed in schools. The project was not aimed at testing or examining any of the above issues. They serve merely as a way of contextualising the problems that exist in many schools trying to meet the demands of a National Curriculum and ICT programmes. What the project has brought to light is that these problems are real, but that teachers are trying to deal with them.

The purpose of the project was to develop, in conjunction with teachers and schools; suitable teaching material based on satellite technology and communication. The material had to be relevant to the National Curriculum in England and Wales, and allow the topic of "Satellite Science" to be taught in a motivating and innovative way. The lessons were originally designed for Year 9 (age 13/14), pupils, (attainment/assessment levels 6 and 7 within the National Curriculum for Science), but could be adapted to suit Year 7 (age 11/12) and Year 8 (age 12/13) pupils, dependent on the approach chosen by the teacher.

The concept of 'Satellite Science', was introduced to the pilot schools as a series of lessons based on 'Earth' and 'Space'. The first part of the lesson entitled, 'Earth' would be carried out in the classroom as an experiment, while the second part of the lesson entitled, 'Space', was to be used in conjunction with the Internet and satellite data. The aim of this section of the lesson was to allow the pupils to compare data gained from their class experiment "Earth" to the same or similar types of experiment carried out in "Space." The data would be accessed via the Internet, which would have a Web-site designated to the project containing all relevant data from the satellite. The teachers regarded the approach as a particularly motivating one and were keen to participate in the project. The teacher's interest stemmed from their desire to enhance their classroom teaching through this innovative approach to delivering a difficult part of the Science National Curriculum.

The schools that participated in the research project had certain commonalties; these were felt to apply to schools throughout the country. They included the need to meet the requirements of the National Curriculum, had a divers spread of pupils, both in age and ability, had access to computers, the Internet and basic scientific equipment.

The pilot schools

Five schools were selected for the project. These schools were identified through a variety of criteria, namely: motivation and enthusiasm for the project, Internet capacity, science expertise and science teaching facilities. Within these broad criteria a cross-section of schools were chosen from urban and rural environments. Three schools in different London Local Education Authorities and two from East Kent were selected. The schools reflected a wide spectrum of ability and range, as well as diversity of school type. These included a boys Grammar school, a comprehensive school, a community school, a High school, and a 'City' technology school. The school rolls were all greater than 700 pupils.

The pilot teachers

Within each school a science teacher was nominated as co-ordinator of the school-based project. Their collaborative role included assisting with the development of the teaching material, designing experiments and trialing pre-developed lesson plans. In total 6 teachers and approximately 360 pupils took part in the initial stage of the project. Each teacher in their respective schools taught five pre-designed and developed lesson plans. The material was given to pupils ranging in age from 11 to 14 over a period of a month.

Teacher A was working in the boys Grammar school. He was an experienced specialist physics teacher, who used the trial material with year 9 pupils, aiming at the higher levels (6 to 8) within the National Curriculum (NC) assessment levels. He considered the material as a stepping stone for further extension work, by exploring the concepts of 'satellite technology' and its implications in both a qualitative and quantitative manner. Teacher B, an experienced specialist chemist cross-curricular teacher was working in a community school, he used the material with Year 7 groups, extracting relevant aspects of the lessons in a qualitative and conceptual manner. Teacher C, an experienced generalist science teacher, teaching in a High school, followed the suggested lesson plans with a Year 9 group and aimed at reaching the National Curriculum assessment levels 4 to 5. The teacher was also looking to develop the existing lesson material further, with particular interest in developing material that would be of value to investigative science. Teacher D, a young specialist biologist cross-curricular science teacher, working in a comprehensive school with low ability groups, (NC levels 2/3/4), followed the pre-designed lesson plans, but had to create suitable lower level exercises and material to suit the groups. Teacher E a less experienced generalist science teacher, was working in an 11 – 16 comprehensive school with Year 9 (NC levels 4/5) groups, followed the lessons as suggested in the pre-designed teaching pack.

The Trial Period

The project was designed to be in three phases. This paper concentrates on Phase 1 the trial period. This was established to run for a month. The teachers were encouraged to use the pre-designed lessons with their chosen year groups. They were asked to collect work covered by the pupils, keep a log of the lessons they taught, and make notes on any changes or developments made to the pre-designed lessons. The research officer maintained contact throughout the trial period by visiting the schools three times. During this period information was exchanged, difficulties and successes discussed, monitored and recorded.

At each visit to the school the teachers were interviewed, (all of which were taped for future transcription and analysis). During the interviews they were asked to comment on each lesson. Specific importance was given to, the successes and failures of the lesson, the pupils likes and dislikes towards the lesson, problems encountered, both in the classroom and with the equipment, access to Information Technology (IT), and the relevance and suitability of the suggested NC assessment levels. The teachers also completed a questionnaire after each lesson. This was to gain responses to the lessons under specified headings. These included: the practicalities of the lesson plan, teacher reaction to the lesson plan, pupil reaction and the methodology used by the teacher to deliver the particular lesson, and the extent to which differentiation was allowed for.

At the end of the trial period a debriefing meeting was held to discuss the following points:

1. How relevant and useful were the pre-designed lessons in terms of the science National Curriculum?
2. How was teaching and learning affected by the use of IT?
3. What particular problems were encountered when trying to teach using the Internet and specified Web pages?

The pilot project outcomes

The overall project had two distinctive strands, that of curriculum development, and that of satellite communication as a new tool for teaching science. For the purpose of this paper the focus of the discussion is the teachers role in using the lesson plans and developing strategies for using new technologies in the classroom. The teachers themselves played an important role in the development of the lesson plans.

The data collected and initial analysis of the material showed two significant areas for science education within the British context, these included:

- *teaching and learning using ICT in science*: this can be subdivided into three issues;
  - i. problems associated with whole class use of the Internet
  - ii. the implications of satellite data and Web navigation can have on learning;
  - iii. problems associated with differentiated skills and knowledge levels
- *relevance of using the Internet to the Science national curriculum;*

Teaching and learning using ICT in science.

All schools within the project possessed Information Technology (IT) capabilities to some degree, but accessibility varied greatly between the schools. One of the schools had instant and permanent access to the Web directly from their classroom. Three schools needed to justify their need for the use of the Web and bid for regular access. The last school had limited access; there was one computer network for the whole school. This had timetabled time; the teacher had to negotiate use of the network for this project. Despite this diversity of hardware access, all the schools were keen to make use of the IT facilities available to them. All the teachers saw the need to develop their own pedagogical skills in relation to ICT, as well as the possibilities it offered for the development of pupil's use of ICT.

The teachers acknowledged that the concept of satellite science had been a significant motivating factor for the pupils, both interest in science lessons and a will to actively participate within these lessons had been noted. Teacher E commented that " these lessons are much more exciting when you get the information from the Internet instead of giving yet another worksheet. Pulling data from the Web and using the computer to help develop ideas is an excellent way to motivate pupils and enhance their learning." Teacher A, commented that "the pupils all seemed very enthusiastic about getting involved with NASA, the Web and space science". A general comment made by the teachers was how mundane experiments such as hot and cold, could be made more exciting when compared to similar situations in space.

The motivational aspect of using a Web-site devoted to satellite communication is without question, however, the teachers did encounter some fundamental problems related to whole class teaching and learning. The teacher interviews clearly show that the problems encountered fall into three distinct areas, that of classroom management, differentiated learning, and hardware failure/support. The following extract taken from Teacher C and Teacher B's interview highlights some of the key issues raised by the teachers generally when thinking about using 'satellite science' through the Web as a means of teaching and learning.

Researcher: Could you see satellite science drive science lessons forward?
Teacher C: Yes, very much, I got very enthusiastic and thought let's plan this and discovered I didn't have the required equipment to conduct all the experiments in the lesson packs

Researcher: How do you feel teaching with the Web?
Teacher C: I think it would be brilliant, but the only problem would be getting access to it, as the rest of the school wants access too!
Researcher: Could you get access once or twice a week?
Teacher C: If we put our case forward.
Researcher: Do you think using the Web is important to science teaching?
Teacher C: Yes, its such a media topic anyway, kids are into it and anything which gets their enthusiasm for science is valuable.
Teacher B: I've got access to a machine in my room-but the Internet was not functioning. Access to either NASA or the designated Web-site is definitely a motivational factor for kids.

Access, availability and reliability were words continually used by the teachers as reasons for not using the Web. For teachers who could not access the Web from their classrooms, found, what could be termed classroom management issues as key to a successful lesson. The teachers frequently referred to lesson timing and planning, minimising time wasting in taking the pupils to the computer centre or network area, making sure pupils had logged on and had the relevant Web pages. Pupils also required clear instructions on how to effectively navigate the Web-site. With classes of 30+ this was not easy. *Teacher B* was most concerned with this aspect stating that: "I do have worries in a sense access is unlimited, you've only got to click on the wrong icon, you can get anywhere and it is difficult to get back and so lose focus. As I have said before, access, network crashes, lack of up to speed modems can all be demotivating factors for pupils, as well as time wasting for the teacher. It's the management of the practicalities that are worrying."

Pupils in most schools worked in pairs or triads, depending on the availability of machines. *Teacher B* highlighted what all the teachers thought in his comment that, "Two pupils per machine for 8-10 minutes leads to problems of practicality, BUT a few on a machine is better than none. Once on the Web-site pupils were expected to find the data sets required for their specified experiment. Downloading data, saving and using data was for some teachers the most demanding part of the Web-site space element of the lessons. All commented on the different levels of skills and knowledge pupils had regarding both scientific knowledge and ICT skills. *Teacher D* suggested that time allowed for computer use in her school was insufficient for this type of work. She stated that "I've been teaching about satellites and this work consolidates what I've been doing. Fits nicely to the scheme, BUT I've got to finish this unit. We need at least 45 minutes on the computer, this isn't always possible or practical." Pressure of fulfilling the demands of the national curriculum requirements for science take precedence over extended use of the Internet or IT alternatives".

The second point raised by the teachers related to "differentiated learning" based on two variables, one being the pupils ICT capabilities and secondly the pupils understanding of the scientific concepts being explored. On the one hand they thought that the ICT component was a great way to help learners of all abilities, as pupils could work at their own pace. Yet, on the other hand they reported that the differing abilities of the pupils, both scientifically and with respect to ICT, gave the teachers problems in managing the pupils' learning, and directing their own teaching of these sessions. What is interesting about this assertion is that the teachers perceived these two areas as classroom management issues, rather than issues related to pedagogic practice. Although, the teachers were concerned about levels of learning in both science knowledge and ICT skills, their responses were clearly demonstrating a concern that related to managing the learning situation as opposed to how they should or could change their teaching style to accommodate a different tool for learning. In this case the computer and the Internet.

Teacher A was clear about the problems that could occur from a combination of complex scientific concepts, ICT skills and teacher interaction with pupils. He suggested that "what you want is to stimulate the kids with this (*space science)*, and this *will* stimulate them. You will want to be able to perpetuate that stimulation and I can see that with some teachers it could go over their heads. You will get pupils going down to the Internet and finding out information and coming back and saying, 'what about this and that', those teachers who are not switched on to space and satellites would have to manage the situation carefully. Flexibility is the key, but depends on the teacher's approach"

When the teachers were asked about teaching with IT, and to comment on the practicalities of using

ICT skills as a means to improving and extending individual pupil's knowledge base, such as graph work, the following responses were recorded (all comments related to the solar cell experiment, fig 1).

Teacher E: Following this experiment the pupils have to plot a graph, both for the classroom-based experiment and the satellite based experiment. It didn't take them long to do the practical side of the experiment. Most of the practical was taken up with them doing the graph. That took a good 15-20 minutes.

Researcher: Would you have liked to try doing the graphs on the computer?

Teacher E: No, I think that would have confused them. They can do graph drawing on the computer, but it takes an awful lot longer than if they'd done it by hand.

Teacher D: The practical was fine, but I had to sketch out the axes for them (pupils), as that takes a long time. I gave them one of the graphs and they plotted it then joined up the dots. They enjoyed that and are getting more skills, which they need throughout the science curriculum, but this section did take 15-20 minutes.

Researcher: Would you have liked to try doing the graphs on the computer?

Teacher D: No, they would find it too difficult and it would take up much more time, which we do not have.

Teacher C: The kids actually had a go at the practical. It was fine. They enjoyed it so that was good.

Researcher: Plotting the graph, was that a successful exercise?

Teacher C: Yes, but, if you are going to give them the axes, it lowers the attainment level. If you're aiming at a higher level, then they (the pupils) should think about it themselves. The concept is good.

Researcher: Would you have liked to try doing the graphs on the computer?

Teacher C: Well, yes and no. If I had unlimited access yes, it would be good way of differentiating and stretching the able pupils. No for the less able as they would struggle. Time would not allow for it. It is best managed as a whole class activity on the board. This way also allows me to quickly see who can or can't do the graph.

Teacher A: What you can get out of this experiment with Year 9 kids and our more able kids is that they can use the graph to calculate a variety of variables. The very able were looking for patterns of results and so on. Our year 9 are just about into Y= MX+C, into a straight line and inverse relationships and we relate that back to maths.

Researcher: Would you have liked to try doing the graphs on the computer?

Teacher A: That's a difficult one. No not in science lesson time. I would expect that type of exercise in maths lessons. We do expect computer-plotted graphs in science, but the pupils do these in their own time.

Teacher B: I did this with Year 7. My worry was whether we could graph the results. Graphs with year 7 are always useful.

Researcher: Would you have liked to try doing the graphs on the computer?

Teacher B: Not with Year 7, possibly with year 9. My only worry is staff would need to have it all mapped out beforehand, access, network crashes, etc. don't bode well to using science time for such activities.

These comments clearly demonstrate the problems the science teacher faced, in terms of differentiated teaching and learning environments. All the teachers highlighted the issue of "time" for science. The pressure to fulfil the requirements of the National Curriculum is clearly stated. It is also clear that the teachers felt that ICT was a motivating issue in teaching "satellite science", but some of the associated problems, such as drawing graphs, was best taught by the teacher. Direct teacher input was considered a more effective means of facilitating individual learning. It is also interesting to note that the only references to pedagogic practice as related to IT surrounds the issue of time management, and not what the new technology learning tool might offer the teaching environment. This view is not new and has been reported in many academic papers, conferences and books (McAteer, E. 1998, Wegrif,R. 1998, Gilliver, R.S. 1998). What is important to the educational context is that despite there having been great leaps in both hardware and software teachers use of new technologies is constrained and not perceived as part of their pedagogic practice.

Relevance of using the Internet to the Science National Curriculum.

Use of the Internet and science education was considered very important to the pupils developing research skills and meeting the ICT components of the National Curriculum. However, teachers were very clear about the implication of teaching/learning time in science, and the way the Internet use eroded this time. Accessing information had to be a definite part of the science lesson, as with the solar cell, and data being accessed directly form the Web to create graphs of light intensity. As Teacher E commented computer/Internet drove the lesson along.

Researcher: Is 'satellite science' a useful concept?
Teacher E: Don't know!
Researcher: Has it a place in the National Curriculum?
Teacher E: We already have a National Curriculum.
Researcher: Do you like the concept of 'satellite science'?
Teacher D: Yes, but this topic isn't entirely relevant in the National Curriculum. They (pupils) won't be asked about it in their Standard Attainment tests (SATs), but the skills that it brings out, graph skills would be.
Researcher: Do you like the concept of 'satellite science'?
Teacher B: Yes, as a motivating aspect to science.
Researcher: Has it a place in the National Curriculum?
Teacher B: Yes, but it is not that easy. The Curriculum prescribes what we teach and at present, this is not in the Curriculum, but I see it as strength that pupils can access NASH and designated Web-sites. The strength of the Web is the flexibility of movement. A real timetable of constant data, a satellite downloading data would captivate pupil's imagination for this reason it should be included.

Teacher A and C consolidate the above views that the Web aspect of satellite science would be an excellent way for pupils to investigate and download their own information and experimental data. They went on to suggest that 'satellite science' would add a totally different dimension to 'Investigative Science' and Attainment Target 1 of the National Curriculum, at all levels.

Concluding Comments

This paper has reported on the first phase of a multifaceted research project that is looking at the concept of satellite science as a means of motivating students' interest in science. The context has been the National Curriculum for Science in England and the use of ICT. What is important to the report is that despite the will to use new technology as a form of pedagogic practice, teachers feel external pressures constrain their use of these technologies. However, pupils were motivated and did produce innovative and constructive work. The development of the lessons by the teachers showed the need to have teachers at the forefront of curriculum development.

The second phase of the project is extending the number of participant schools and teachers. It is also going to look at other areas of the National Curriculum to see how satellite science can enhance the quality of student learning.

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Research Training via the Internet: Developing Web-based Resources for Art and Design Postgraduates

Darren Newbury, Birmingham Institute of Art and Design,
University of Central England, United Kingdom
Email darren.newbury@uce.ac.uk

Abstract: The increasing accessibility of the Internet as a tool for the delivery of educational content and interaction, combined with its importance as a source of information for researchers provided the rationale for the project described in this paper. The paper reports on the development of a web site to support the teaching of research skills to postgraduate students in art and design. The model of development adopted by the project is presented and discussed, with a particular focus on three issues: the revision of existing content for web-based delivery; the development of a web-based form of presentation; and the consideration of how to structure students' use of the resource. In conclusion the paper looks at the piloting and evaluation of the site and areas for future development.

Introduction

Postgraduate education in art and design, in common with many other areas of postgraduate study is undergoing a period of considerable change. Three factors are of particular importance to the resource development project discussed in this paper [1]:

- the increase in the number of postgraduates and postgraduate courses (this has been a general trend affecting most subject areas in higher education)
- the question of what constitutes research in art and design, and what therefore might be considered an appropriate body of research skills
- the significance new developments such as the Internet for teaching, learning, and research

Art and design, like many other areas of postgraduate education, has experienced a considerable increase in the number of students attending taught courses and registering for higher degrees, both in real terms and in proportion to undergraduates. The recent Review of Postgraduate Education in the United Kingdom gives an indication of the extent of this change:

> "In 1979, for example, there were 100,900 postgraduate students in the UK compared with a total student population of 787,000 (13%), whereas in 1994-5, the comparable proportion was 21% (315,400 and 1,538,600 respectively)." (HEFCE 1996)

This general trend towards greater student numbers at postgraduate level has been accompanied by two further developments. Firstly, there has been a lively international debate concerning the nature of research in practical and creative subjects such as art and design [2]. This has in part been driven by the increasing number of students wanting to progress to doctoral work in these areas, but also represents some interesting debates about the nature of knowledge and enquiry in fields of creative and practical endeavour. Although this area of discussion is beyond the scope of this paper, the consequent importance accorded to the teaching and learning

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[1] The development of the research training web site forms part of a broader project – the Research Training Initiative – initiated in 1995 to develop and publish research training resources for postgraduates in art and design (see Newbury 1996). To date the project has published seven printed research guides (all but one of which are now out of print) and a CD-Rom of case studies of masters projects in jewellery and silversmithing (Newbury 1997). Further information about the project can be found at http://www.biad.uce.ac.uk/research/index.html.

[2] See for example *No Guru, No Method* conference proceedings (Strandman 1998), Gray 1995, UKCGE 1997.

of research skills has been significant for this project. Secondly, the increasing accessibility of the Internet is having a significant impact on the way in which staff in higher education think about teaching and learning [3].

Although electronic resources are often put forward as an efficient solution to the problems raised by increased student numbers without a comparable increase in teaching staff, the majority of work to date has been in relation to undergraduate (often modular) programmes. A brief review of resources currently available suggests that relatively little of the work in this area has been at a postgraduate level [4]. The emphasis on the world wide web and CD-ROMs as virtual storehouses of knowledge and information has tended to favour subjects with large, well structured and relatively stable knowledge bases, rather than practice-based subjects such as art and design where much of the subject knowledge has not been committed to textbooks. Many computer-based learning packages also have a very directive style and are therefore less suited to the more open investigative learning appropriate to postgraduate level study. This is perhaps slightly ironic in that the Internet and the world wide web were originally developed by and for researchers. As Hobbs and Taylor point out:

> "Researchers are still some of the keenest users of the WWW in view of its potential for contact and collaboration, for disseminating research findings, and for facilitating peer review of the outcomes of research." (Hobbs & Taylor 1996)

The development of the research training web site discussed in this paper is a response to this context. An important difference between undergraduate and postgraduate study is that the postgraduate student must learn to find and manage the information that supports his or her own learning. Postgraduate students beginning research for their dissertation or major project are confronted by a complex landscape of information sources. It is interesting that what can be considered a disadvantage of the world wide web for undergraduate students – the lack of any clear narrative which structures the learning process (Laurillard 1995) – has advantages for research students – the direct access it gives to sources, databases, other researchers and even research subjects (Foster 1994). However, it was novice rather than experienced researchers that were the focus of this project. It was therefore important that the material we produced supported students' independent learning and research, as they began to deal with a complex range of sources from which to retrieve information. Our proposal therefore was to take as a starting point material already available on the collection and management of information for research, and to develop from this a web-based interactive environment which would support the learning of a number of key research skills.

A Model of Web Resource Development

New educational technologies have strengthened the trend towards specialisation in the development of teaching and learning. In addition to subject knowledge, two specialised domains of knowledge are emerging. Firstly, knowledge of teaching and learning processes. As Laurillard points out, innovative teaching methods, by which she means those that depart significantly from the narrative or telling mode, "require more pedagogical understanding of the professional teacher" (Laurillard 1995, p.183). Secondly, specialised knowledge in the design (in its broadest sense) of computer-based teaching and learning materials. There is an emerging literature on models of developing electronic resources, which attests to the novel and still problematic nature of this kind of resource development (Borkowski et al. 1996; D'Halluin et al. 1996; Porritt 1997). Porritt, for example, identifies a further degree of specialisation. He outlines four roles - student; tutor; author; designer – and considers the different models of interaction and overlap. These range from the "tutor designer" within which the tutor takes on the additional roles of author and designer, to "open authoring" within which resource development is carried out by teams made up of specialist tutors, authors and designers. Although these specialist areas are separable in theory it is often the case that the discussion of computer-based

[3] When we originally surveyed our higher degree students prior to developing the training resources they indicated that electronic resources were among the least flexible and desirable forms of delivery. Although this situation has changed, many more students now have Internet access, its appropriateness needs to be considered on a case by case basis. On a larger scale the question of the accessibility of web-based course material has been an issue for the Open University where the development of innovative distance learning materials has had to be matched with its policy of accessibility.

[4] There are of course some exceptions to this general observation. See for example Jennings 1997 and Lidstone & Lucas 1998.

learning has become part of a broader debate around innovations in teaching and learning. In some instances computer-based learning developments are seen as a vehicle for introducing changes in teaching practice that are in themselves considered desirable. Underlying this is the view, perhaps not always justified, that there is an inherent compatibility between computers and certain philosophies of education.

This developing context has given rise to a range of approaches to the use of the Internet and multimedia technologies for teaching and learning, from small local developments by enthusiastic teaching staff to large scale centralised funding [5]. The development of this project drew on a number of extant models and had the following five features:

- Specialised content development. The project was a response to developments in the subject area as well as to the introduction of the Internet as a tool for teaching and learning. As a result we had produced a range of new material on research in art and design during the three years of the project. It is also worth noting that the print format we adopted - a series of research guides rather than a sequential programme or single publication - provided a degree of flexibility that proved useful in its conversion to electronic format.

- Central resourcing at a faculty level. A degree of central resourcing meant that the work was not additional burden for already busy teaching staff and therefore enabled the development to get off the ground. However, it was important that the resource retained a subject identity given the relative novelty of research study in art and design (although much of the material had generic applicability). Unlike a number of other universities, which have adopted a university wide approach to research training, our initial audience was specifically art and design students.

- Core team responsible for the resource development. Importantly, however, the main member of staff working on the project was also delivering teaching in research methods on a number of courses. This enabled the resource to be developed in a way that was responsive to student and tutor needs. The use of an intranet/internet based resource offered an opportunity to supplement existing classroom teaching with resources that students could access at times when it was most needed, principally during the period of independent research study.

- Skills development. Although it is possible to consider teaching staff simply as "information owners" (Borkowski et al. 1996), with content handed over to a specialist team for the creation of web pages, this represents only a base level model of development. In this project the member of staff responsible for content development was also responsible for the overall design and navigation of the site. This necessitated learning to use basic web page software. Although the final screen design and authoring was not done this way, the drafting of the pages and site architecture in web format made it possible to think through important issues about how students would use the information. It also highlighted some basic issues such as the need to carefully structure large amounts of text to be accessible on screen.

- Professional design input. The final stage of the project involved working with a professional web design team. Although design in its broadest sense was set largely at an earlier stage, the design of the pages on screen has the potential to either enhance or detract from the overall structure. Given that the project was situated within a faculty of art and design and that it was for use by art and design students, it was considered important that the finished site should be visual attractive, pleasant to use and functional. This stage enabled us to make use of some features of advanced web page authoring which would have otherwise been beyond the skills of the team.

One of the key principles that emerged from the model of development used in this project was the importance of a close integration between the different stages in the process, from content generation to screen design to the placing of material within the curriculum.

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[5] For example, in the United Kingdom the Teaching and Learning Technology Programme (TLTP) has invested a total of £37 million since 1992 in the development and implementation of technology based learning. Many of the projects has been at an institutional or inter-institutional level.

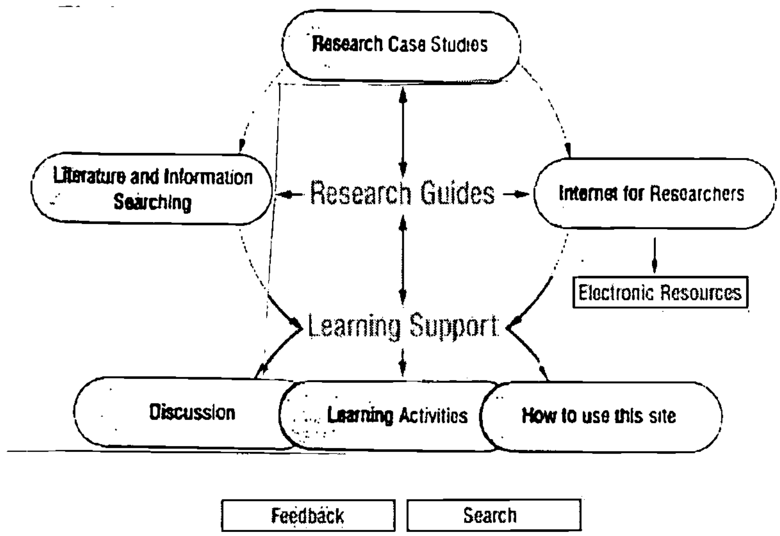

Figure 1: Map of pilot website contents

Contexts for Electronic Learning

One of the dangers of a specialised production model of electronic resource development is the failure to give sufficient consideration to the contexts into which materials are being introduced. The emphasis is placed on the knowledge content at the expense of the processes of teaching and learning. As within any form of teaching there is a need "to change information exchanges into learning activities" (D'Halluin et al. 1996). In order to avoid the pitfall of offering students content without an appropriate learning context or framework, we incorporated two additional features into the web site: a discussion forum; and guided learning activities.

The discussion forum serves three purposes. Firstly, it provides for student interaction both within and across sites (the piloting of the resource is taking place across several universities). It is hoped that this will enable students to share problems and solutions, and disseminate useful information. Secondly, a number of the learning activities invite students to post short written pieces to the forum, for example reviews of particularly good or bad web sites. This is one way of prompting students to think about writing for a semi-public audience. It is envisaged that this may be appropriate as a form of coursework, with the archived messages providing an easy means of assessing students' contributions. Models of practice in this area already exist, though largely at undergraduate level. Thirdly, electronic discussion lists are now an important form of academic research networking (Berge & Collins 1995). It is important therefore that research students are introduced to this form of communication, its benefits and limitations. Although advances in Internet technology mean that video conferencing is becoming increasingly viable, the move towards the "conversational ideal" (Jones 1995) in electronic communication should be subject to scrutiny. The dynamics of asynchronous email communication have some useful advantages for both for research, and for teaching and learning. For example, as something of a hybrid between written and spoken forms of communication, email can offer the opportunity for considered responses without introducing the formality of written essays. It can also reduce some of the inhibitions to participation that exist in face to face encounters (though of course it does introduce new problems of its own).

The learning activities on the site have been designed to facilitate students' use of the content – there are cross links between activities and relevant sections of the electronic research guides – and also to help students to develop strategies for gathering information relevant to their research topic. The site has been constructed to serve a number of different student groups, and at this stage is a supplement to existing teaching rather than a compulsory element. This will obviously have a bearing on students' use of the material and is something we have had to consider carefully. As a result the learning activities try to fit with tasks that students will need to do anyway in order to complete an independent research project. It is important that the activities are optional, as they will not be equally appropriate to all student projects. Also some students' prior knowledge may mean that completion of a particular activity is unlikely to be relevant. For example, for those students already familiar with the use of email discussion lists the activity related to this may be redundant.

These features are intended to provide a learning context that supplements the traditional class or seminar group and guides students' use of electronic sources and the Internet, which despite claims to the contrary can be a sparse and isolating learning environment.

Evaluation: Issues and Methodology

The evaluation of web-based resources is key to the future development of this area of work. The number of new initiatives in web-based learning raise issues both of comparison and also of the sharing of good practice. The evaluation of the web site in its pilot form will consider several aspects:

- Navigation and interface design - the ease with which students were able find their way around and use the materials.
- Interaction – the quality of the interaction in relation to the materials and the suitability of the discussion forum facility for this purpose. The evaluation will also consider what factors may affect the success or failure of this aspect of the site.
- Added value – what the web-based materials contributed to teaching and learning, and the appropriateness of using the web.
- Context – the value and appropriateness of the context in which the materials were introduced and the way in which students' use of the materials was structured (for example through the guided learning activities)

Although it is our intention to monitor the use of the web pages quantitatively, we are principally concerned at this stage with the *quality* of the interaction with the materials within a relatively small user group. The methodological emphasis is therefore on the students' experience of using the materials and tutors' perceptions of the value it added to traditional teaching methods in this area. The evaluation methodology will therefore incorporate the following elements:

- Focus group discussion with small groups of students
- Collation and analysis of discussion forum interaction
- Interviews with tutors
- Expert reviews

Although we intend the material to support students during a relatively long period of independent research study, in order to get some timely feedback we will carry out the piloting over one 15 week semester period. Several small groups of students will be introduced to the resource at the beginning of the semester. They will then have access to the resource throughout the period, with the main evaluation work taking place towards the end. The pilot groups cover both taught masters and research students across a range of art, design and media subjects. This will give some variation in the degree to which students' use of the resource will be guided, and hopefully provide some indicators as to what different students might want from such a resource. In addition a small number of expert reviews will be commissioned in order to subject the material to independent scrutiny, and give some measure of how this work relates to the current 'state of the art'.

Conclusion and Future Directions

The web site is at a pilot stage, and it is difficult to come to any specific conclusions before the process of piloting and evaluation is complete. However, it is worth venturing two general thoughts. Firstly, it seems that to some extent the project is representative of interim work in this area. There is currently a great deal of unevenness in postgraduate students' prior knowledge and experience of the internet. Some will of course be highly proficient and experienced users, others however will have little or no knowledge and experience other than that gleaned from popular representations. However, over time this is likely to change dramatically and resource developers will need to respond to the needs of a more sophisticated group of users. A similar point can be made in relation to staff. The development of web-based materials is new to most academic staff outside of computing and information science. It therefore makes sense to provide additional support in this area. However, in the long term the specialised model of resource production this implies has potential dangers. As I have argued, students and academic subjects are likely to be served better where there is a close integration between subject knowledge and tools for teaching and learning. It seems obvious that a subject tutor needs to understand how the lecture or the seminar works in order to teach. It should be no less obvious that they need to know how their students make sense of electronically based resources. Though as has been noted this does place extra demands, both intellectually and in terms of time, on staff.

Coda

One area not discussed in this paper but important to the philosophy of the project is the use of case study material as resource for teaching and learning. One of the printed research guides was given over to a series of case studies of completed MPhil and PhD projects in art and design. An important area for the future development of this project is the introduction of case study material on to the web site. The use of web-based materials offers an opportunity and a challenge, to develop multimedia forms of the case study approach.

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"But Does It Work?" 6 Ways to Evaluate Technology

Rob Foshay, Ph.D.
PLATO® Education
USA
Rfoshay@plato.com

Abstract: This paper outlines six basic evaluation designs. For each, the paper describes the type of technology application for which it is appropriate, and the questions the evaluation design can answer, and summarizes the requirements, data collection and analysis procedures. The six evaluation designs are:

- Mastery-Based Program Effectiveness
- Non-Mastery-Based Program Effectiveness
- Affective Outcomes
- Case Studies / Qualitative Assessments
- Program Comparison
- Cost Comparisons

A more lengthy version of this paper includes details on the requirements for successful evaluation, the procedures for data gathering, and the procedures for data analysis, and guidelines for writing the evaluation report. It is available at http://www.plato.com, or from the author.

Introduction

It is sound educational practice to evaluate the effectiveness of any instructional program, including technology-based implementations. But it's important to use an evaluation design that is appropriate to the way in which you are using the technology, and to your needs for decision-making. When evaluations are inconclusive, it's often the case that an inappropriate evaluation design was used, and the desired result could not have emerged from the evaluation.

To decide what kind of evaluation to do, you must first know who will use the evaluation results and what decisions they need to make. You can then combine and adapt these basic designs to meet your program's needs.

Which Model Do I Want?

Here is a brief summary of the programs to which the six models often apply. For a more complete description, refer to Foshay (1994).

Mastery-Based Program Effectiveness

In programs suitable for this model, the technology provides the primary means of initial instruction, and learners are managed so that learners begin a learning activity only when they are ready for it, and they continue to study the activity until they have fully mastered it. Thus, in contrast to a conventional instructor-led classroom, achievement is fixed but instructional time varies. As an example, mastery-based instruction is typical of GED programs.

Questions

Use this design when you want to find out:

- How well are the learners progressing due to the technology?
- What is the longest, shortest, and average time to mastery?
- What proportion of learners master the skills taught at the required level?

- What proportion of learners do not complete or drop out?

If the technology is the primary instructional mode in a mastery-based program, learning outcomes can be attributed mostly to the technology.

In addition to these questions, people sometimes wish to know about long-term retention of what's learned. Unfortunately, research on long-term retention indicates that it begins as a product of initial level of mastery and the way in which topics are taught, but that by far the biggest single factor influencing long-term retention is whether the learner has an opportunity to use what's been learned. Consequently, there is no simple way to evaluate long-term retention due to any type of instruction.

Non-Mastery-Based Program Effectiveness

In a non-mastery program, instructor-led classes typically are the primary means of initial instruction. It is more for the technology to be used in a complementary or supplementary way. Learners are managed so that instructional time (pacing) is fixed and achievement varies.

Questions

Use this design when you want to find out:

- How well are the learners progressing in the program as a whole?
- What is the longest, shortest, and average time on PLATO?
- What proportion of learners master skills at the required level?
- What proportion of learners do not complete or drop out?

Affective Outcomes

In any evaluation, it's common to be interested in how learners and instructors felt about their use of the system, their confidence and their role in the instructional process.

Research has shown that affective outcomes are largely independent of actual learning. Thus, asking learners how they felt about the value of a course or whether they achieved its objectives is not an adequate substitute for measuring learning using either of the two "program effectiveness" evaluation designs above.

Questions

Use this evaluation design when you want to find out if learners using the technology generally feel...

- good about their experience?
- unembarrassed by wrong answers?
- in control of their learning?
- rushed?
- the system is relevant to their needs?
- the system accommodates their preferred learning style?
- confident of their ability to succeed?
- more goal-oriented?
- motivated to use the system effectively?

And, if instructors using PLATO generally feel...

- good about their experience?
- able to spend more time 1-on-1 with learners?
- in control of the instruction?
- a generally good understanding of what PLATO teaches (and does not)?
- well prepared for the changes?
- adequate time to use the system effectively?
- adequately trained to use the system effectively?
- motivated to use the system effectively?

You can answer these questions at the end of the program, or you can do a "before and after" comparison in which you measure expectations and current attitudes ("before") against actual feelings at the end of the program.

Case Studies/Qualitative Studies
Decision-makers often have difficulty drawing appropriate conclusions from purely numerical evaluation studies. Some decision-makers have an overt distrust for quantitative studies: "figures lie and liars figure." In addition, evaluations which summarize results for an entire group require considerable effort to do, and often aren't available until long after completion of the program. In non-mastery-based classrooms where technology is not the only instructional element, it may not be possible to use a quantitative design to study the effects of the technology. Finally, many people find numerical evaluations too abstract to say what's really important. This is often the case, for example, with collaborative learning programs.

A case study (qualitative) evaluation is an alternative which addresses these criticisms. In general, a qualitative evaluation can:

- Serve as a useful complement to a numerical evaluation, and "put a human face on the numbers."
- Carry more "face validity" than a numerical study, and thus have more impact with some decision-makers.
- Be prepared quickly and at low cost if the number of learners is small.
- Contain "narrow but deep" descriptions of one or more experiences with the program, rather than "wide but shallow" generalizations common of numerical evaluations.

Among the limitations of qualitative studies are:

- Observations are true only of the learners interviewed and may not be generally true.
- Data collection is less objective than numerical studies.
- Including the learner in the study may be an added motivator not available to most learners. This can lead to biased conclusions.
- Data collection and interpretation is costly unless numbers of participants is very small.

A qualitative evaluation can be used instead of or in addition to a more conventional numerical evaluation.

Questions
Use this design when you want to ask:

- What are the needs of the learner?
- What is the motivation and the goals of the learner?
- What is the learner's pattern of technology usage?
- How has the learner integrated the technology with other learning experiences to achieve the class' learning goals?
- In learning from the technology, what facilitators and obstacles were encountered?
- How has the technology usage affected the learner's confidence?
- What have been the learning outcomes for that learner?

Program Comparison

There is over 25 years of research showing that people can learn from computer-based instruction, and that on the whole CBI implementations achieve greater gains in less time than large-group classrooms. However, it is still true that decision makers often want to know if using technology is an improvement over whatever is being done now in their program. Unfortunately, meaningful evaluations of this type require carefully controlled "experimental" designs and are very difficult to do well. There are a number of reasons for this:

- "Whatever is being done now" is often imprecisely defined and varies widely from instructor to instructor, class to class and semester to semester.
- It's common to change more than one thing in a program when technology is introduced, so it's impossible to attribute specific changes to the technology.
- An interpretable "experiment" has requirements which are incompatible with many program structures.

- Everyone's performance improves for a while when they know they're "part of an experiment."

Questions
Use this design when you want to ask:

- What learning gains occur using technology, when compared to our conventional practice?
- What percentage of learners achieve a predetermined mastery level using technology, when compared to our conventional practice?
- What is the longest, shortest and average time to reach mastery level using the technology, when compared to our conventional practice?
- What are the effects of using technology on completion/dropout rate, when compared to our conventional practice?
- Are any of the above comparisons large enough that we can say with confidence that they are not due to chance alone?

Cost Analyses
Program administrators sometimes want to cost-justify use of technology on the basis of reduced (or avoided) costs, increased enrollment income, or increased benefit to the host organization. This kind of cost-effectiveness justification is based on a comparison of the results of conventional and technology-based programs arrayed against the cost of each.

Do not confuse a cost-effectiveness study with a simple cost-cost comparison, in which the costs of the conventional and technology-using programs are compared without reference to the effectiveness of the programs.

Also, do not confuse cost-effectiveness with a cost-benefit study. A cost-benefit evaluation might be done for a new program to see if it is meeting its projected costs and benefits. To do a cost-benefit study, you would use the "Mastery-Based Program Effectiveness" or "Non-Mastery-Based Program Effectiveness" evaluation models, and collect appropriate cost and enrollment income data as well. If your program is justified on the basis of benefits to a host organization or the general community, then you may also be able to gather cost-avoidance data such as reduced follow-on training time, reduced equipment downtime, reduced plant or process startup, and so on. In either case, there is no comparison in a cost-benefit study with an existing program.

To do a cost-effectiveness study, you must use the "Program Comparison" design. Then you must decide if you want to do the cost analysis on the basis of reduced costs or increased enrollments. If you choose to use reduced costs, then add to the evaluation a costing model for each treatment. If you choose to use increased enrollments, then add to the evaluation design a comparison of enrollments (or retention) in each program.

Evaluation Procedures Summary

Often, you'll want to combine the evaluation designs. To help, the tables below include evaluation requirements, data gathering and data analysis procedures for the six evaluation designs.

Requirements

Require-ments	Mastery Prog. Eff.	Non-Mastery Prog. Eff.	Affective Outcomes	Case/ Qualitative	Program Compari-son	Cost Compari-son
Learners match user profile	x	x	x	x	x	x
Unlimited access	x				x	
Individual placement	x				x	

Require-ments	Mastery Prog. Eff.	Non-Mastery Prog. Eff.	Affective Outcomes	Case/ Qualitative	Program Compari-son	Cost Compari-son
Individual routing	x				x	
Work @ own pace	x				x	
"Place out" with module tests	x	x	x	x	x	
Pass module test to go on	x	x	x	x	x	
Offline tests must be aligned	x	x			x	
Offline Learning activities aligned & synchron-ized	x	x			x	
Random assignment					x	
Parallel content					x	
Post-test in 3 days of completion	x	x			x	
Implement-ation training, support & monitoring	x	x	x	x	x	x
No contact between classes					x	

Data Gathering

Require-ments	Mastery Prog. Eff.	Non-Mastery Prog. Eff.	Affective Outcomes	Case/ Qualitative	Program Compari-son	Cost Compari-son
Pre-test & prescription	x	x			x	x
Monitor implemen-tation	x	x	x	x	x	x
Mastery/ completion	x	x	x	x	x	
Time	x	x			x	x
Post-test in 3 days	x	x			x	x
Question-naires			x			

Require-ments	Mastery Prog. Eff.	Non-Mastery Prog. Eff.	Affective Outcomes	Case/ Qualitative	Program Compari-son	Cost Compari-son
Interviews/ focus groups before, during & after			x	x		
Logs/ writing				x		
Cost data						x

Data Analysis

Require-ments	Mastery Prog. Eff.	Non-Mastery Prog. Eff.	Affective Outcomes	Case/ Qualitative	Program Compari-son	Cost Compari-son
Convert pre/post scores	x	x			x	x
Gain scores	x	x			x	x
Pre-post paired bar graph	x	x				x
Gain bar graph					x	x
t-test	x	x			x	x
Between groups comparisons					x	x
Mastery/ completion %	x	x			x	x
Time on task	x	x			x	x
Mastered vs. non-mastered time	x	x			x	x
Cost summary/ comparison						x
$ Benefit summary/ comparison						x
Non-$ benefit						x

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Authoring Computer-Based Instruction for Teaching Concepts Using Instructional Event Shells

Yun Ni and Jianping Zhang
Department of Computer Science
Utah State University
Logan, UT 84322-4205 USA
jianping@zhang.cs.usu.edu

Abstract
This paper reports our work towards the development of an authoring system for automating the instructional development of adaptive instruction for teaching concepts. The core of our work is the design of a set of instructional events for concept teaching, *Introduction, Demonstration, Practice, and Test*, and the development of corresponding instructional event shells. An instructional event shell is a piece of program code that executes an instructional event. The focus of this paper is a description of these instructional events and their shells and how these instructional event shells can be used to author computer-based instruction for concept teaching. Issues related content-based and event-based authoring will also be discussed.

Introduction

With the rapid advances of computer network and multimedia technologies, the use of interactive instructional technologies has been experiencing a dramatic increase in recent years. However, development of high quality computer-based courseware is both time consuming and labor intensive. Therefore, only the best funded training programs can afford to be computer-based. Many organizations that are attracted to the concept of computer-based training have to give up when they discover the cost and the time to implement computer-based courseware.

A traditional computer-based courseware development team involves subject matter experts, instructional designers, and programmers. The subject matter expert determines what to teach and provides subject matter knowledge. The instructional designer together with the subject matter expert determines how to teach and designs the instructional treatments for subject matter knowledge to be taught. The programmer generates computer code to implement the instructional treatments for the delivery of the instructional material. The development processes of both instructional design and programming are very long and labor intensive even for some simple training programs.

To reduce the time and cost spent in programming, authoring systems have been developed and used widely. The goal of existing authoring systems is to eliminate programming in the courseware development process and lift the expensive burden from the course developer's shoulders. Solving the programming problem for course developers with authoring systems has greatly influenced the productivity of development of computer-based instruction, and the number of interactive instructional software products has increased geometrically.

However, the current conception of authoring systems has not solved the cost and time problem to a sufficient degree. The quality of many current instructional products still appears to be far below the potential promised by the current computer technology. Even though the expensive programming burden has been lifted from the course developer's shoulders, there remains a equally cost and unnecessarily repetitive instructional design process burden which still rests on the developer (Merrill, 1985).

Merrill and his colleagues (Merrill, Li, & Jones, 1991) introduced the instructional transaction theory that maintains that the basic building block of instruction should be the instructional transaction. This principle applies particularly to the highly interactive medium of computer-based instruction, in which the most powerful vehicle for learning is the pattern of interactions between the student and the computer. Based on the instructional transaction theory, a simple prototype named ID Expert (Merrill & Li, 1989) was developed. ID Expert was intended for use by both novice subject matter experts and experienced instructional designers and provides instructional design and templates for courseware developers. The instructional transaction theory provides a theoretical foundation for the development of authoring systems that automate the instructional design of computer-based instruction (Zhang, et al., 1997). Recently, a few commercial authoring systems such as ToolBook and Authorware included some templates or widgets that speed up the courseware development process.

This paper reports our work towards the development of an authoring system for automating the instructional development of adaptive courseware for teaching concepts. The core of our work is the design of a set of instructional events for concept teaching, *Introduction, Demonstration, Practice, and Test*, (Merrill, et al., 1992) and the development of corresponding instructional event shells. An instructional event shell is a piece of program code that executes an instructional event. The focus of this paper is a description of these instructional events and their shells and how these instructional event shells can be used to author computer-based instruction. The ideas introduced in this paper are being implemented in an authoring system named ConceptAuthor.

Course Structure And Concept Representation

A concept is a set of specific objects, symbols, or events which are grouped together on the basis of shared characteristics and which can be referenced by a name. Authoring a course using ConceptAuthor is to create a course structure and provide content material for all concepts to be taught. The course structure and the content materials of concepts are stored in a database. The course structure is separately stored from the content materials. This section discusses the course structure and concept representation implemented in ConceptAuthor.

Course Structure

A course structure is a tree of course units. The root of the tree is the course and the leaves are instructional events. A course may consist of a set of events and a set of lessons. Instructional events of a course may be a pre-test, a post-test, a course introduction, a course summary, and a comprehensive practice.

A lesson may be composed of a lesson introduction, a lesson summary, a comprehensive practice, a test, and one or more instructional sessions. An instructional session may consist of a set of instructional events and zero or more other instructional sessions. A session may teach one concept or a set of coordinate concepts.

Concept Representation

Each concept in ConceptAuthor is stored as a frame that stores the information about the concept. Information stored in the frame may include the concept name, the concept definition, the concept context, and a list of concept characteristics, lists of discriminans, the concept instances, and the problems. The concept name and definition are required while all others are optional.

The concept name is a string and a concept may have more than one name. Most likely, a concept definition is a paragraph of text, but it could also be some other media such as audio, video, and images. A concept may have several definitions. Especially, when a concept is very complex or disjunctive, the teacher may want to teach the concept in several steps. First, a simple definition is taught, and then this simple definition is gradually expanded until a complete definition is taught. The concept context specifies where, when, and how a concept is used.

A concept characteristic is the property that holds for all examples of the concept. When a concept is fuzzy, a concept characteristic may only hold for all typical examples. A concept characteristic may be a property or a relation. A concept discriminant is a property or a relation that discriminates the concept from its coordinate concepts.

A concept instance is either an example or a counter example of the concept. Some instances are more typical (representative) than other instances. Some instances are easier to understand than other instances. Problems are used for practice or tests. There could be many different types of problems. The types of problem will be discussed in Section 3.

A set of related concepts may form a concept taxonomy. In this taxonomy, a concept may consist of several subordinate concepts. A subordinate concept may be a kind of its superordinate concept or a part of its superordinate concept. Coordinate concepts are a set of concepts in which each member shares the characteristics of the same superordinate concept (Merrill, 1992). The course developer may intentionally group a few concepts for some instructional purpose.

Instructional Events for Teaching Concepts

Concepts may be taught using four instructional events: *Introduction*, *Demonstration*, *Practice*, and *Test* (Merill, et al., 1992). These four instructional events may be used repeatedly. In ConceptAuthor, four corresponding instructional event shells are being implemented to execute these four events.

Introduction Event

An introduction event introduces to a concept to the student by presenting the concept name, the concept definition, and the concept context. In addition, this event also shows the student a representative example of the concept. All materials may be presented using different media such as text (rich text format), pictures, still images, animations, audio, and videos. All materials may be presented in one or more pages. Hyperlinks are allowed.

A set of coordinate concepts could be introduced in sequence or in parallel. If concepts are introduced in sequence, each introduction event only presents materials of one concept. An introduction event presents materials of two or more coordinate concepts if they are introduced in parallel. When coordinate concepts are introduced in parallel, the differences among these concepts may be compared and presented.

For a complex concept or a disjunctive concept, an introduction event may only present a part of the concept definition. Namely, a concept definition may be presented using several introduction events.

Demonstration Event

A demonstration event presents the student a sequence of instances (examples and counter examples of the target concept.) Instances presented should be as divergent as possible. Namely, they should cover all aspects of the target concept (examples of every disjunct and examples showing every characteristic of the target concept.) Easy and simple instances should be presented before difficult ones. Typical instances should be presented before atypical ones. Near miss counter examples could be more useful than other counter examples so they should be presented more often than other counter examples.

Instances may be presented together with the concept definition. Each time an example or a counter example is presented to the student, an explanation of the example or counter example may be available upon the request of the student. At any time, the student may inform the event how well he/she understands a presented instance. Presentation of instances may be adjusted according to the student feedback.

Similarly to an introduction, instances of coordinate concepts may be demonstrated in sequence or in parallel. When demonstrated in sequence, only one instance is demonstrated each time. When demonstrated in parallel, multiple instances of different concepts are demonstrated simultaneously. When instances of different concepts are presented in parallel, differences among the instances of different concepts may be highlighted.

For a complex concept or a disjunctive concept, a demonstration event may only present a subset of instances of a concept. Namely, all concept instances may be presented using several demonstration events.

Parameters of a demonstration event may include difficulty level, example number, counter example number, instance presentation order, explanation mode, and control mode.

Difficulty level is the average difficulty level of all presented instances. Example number is the number of examples to be demonstrated. Counter example number is the number of counter examples to be demonstrated. Instance presentation order is the order in which instances are presented. The possible presentation orders include, from easy ones to difficult ones, from typical ones to atypical ones, random, examples before counter examples, one example and one counter example, simultaneous demonstration of examples and counter examples. Explanation mode determines if an explanation of each instance should be provided or not or upon the request of the student. There are two control modes: learner control and system control. What can be controlled include which instances to be demonstrated, the amount of instances to be demonstrated, the order in which instances are demonstrated. The student may have no control at all, partial control, or total control. If the student has total control, a list of all instances will be provided for the student to choose. Learning guidance is always available for the learner control.

Practice Event

A practice event provides an opportunity for the student to apply what they learned in the introduction and demonstration events. The following is a list of different types of problems.

True/False:

Instance I is an example of concept C.
Instance I is a counter example of concept C.
Properties $P_1, \ldots, P_n$ are characteristics of concept C.
Properties $P_1, \ldots, P_n$ are not characteristics of concept C.
Properties $P_1, \ldots, P_n$ discriminate concept C_1 from concept C_2.
Properties $P_1, \ldots, P_n$ do not discriminate concept C_1 from concept C_2.
Instance I is an example of concept C because of Properties $P_1, \ldots, P_n$.
Instance I is a counter example of concept C because of Properties $P_1, \ldots, P_n$.

Multiple Choice:

Which of the following concepts does instance I belong to?
Which of the following instances is an example of concept C?
Which of the following properties is a characteristic of concept C?
Which of the following properties is not a characteristic of concept C?
Which of the following Properties discriminates concept C_1 from concept C_2.
Which of the following Properties does not discriminate concept C_1 from concept C_2.
Instance I is an example of concept C because of which of the following Properties.
Instance I is a counter example of concept C because of which of the following Properties.

Matching:

Given n instances and n concepts, match one instance to one concept.
Given n properties and n concepts, match one property to one concept. A property matches a concept if the property is a characteristic of the concept.

Fill-In-Blank:

Given an instance, name the concept to which it belongs.
Given a concept, name one or more characteristics of the concept.

Problems may be automatically generated by the system or provided by the course developer. After a question is answered, the system may ask the student to provide an explanation for his/her answer. This may be just another question in one of the formats specified above. Hints for each problem may be available. Some examples of hints are concept definition with important characteristics highlighted, a similar problem with its answer, demonstration of a similar instance, and hints given by the course developer. After an answer is given, feedback will be provided. If the answer is correct, some reinforcement message may be given. If the answer is not correct, feedback may include the correct answer, the explanation of the correct answer, why the answer given by the student is not correct, and reference materials relevant to the problem.

Problems given to the student should be as divergent as possible. They should cover all aspects of the target concept. There should be some easy and simple problems as well as difficult ones. Easy and simple problems should be given before difficult ones. The practice event is adaptive and the amount of problems to be given and which problems to be given, and the difficulty level of the problems are dynamically adjusted based on the student performance.

Parameters of a practice event may include: difficulty level, amount of problems, problem type, hint, feedback, and control mode.

Difficulty level is the average difficulty level of all problems. Amount of problems is the number of problems to be presented. Problem type is the percentage of problems to be presented for each question type. Hint is if hints should be available or which hint should be available. Feedback is if feedback should be provided or how much should be provided. There are two control modes: learner control and system control. What can be controlled include the amount of practice problems and the types of problems. The student may have no control at all, may have partial control, or may have total control. If the student has total control, he/she determines if he/she needs more practice and the type and the area of the problems he/she wants to solve. Learning guidance should always be available for learner control. An exploration event could be developed using the demonstration event shell with learner control.

Test Event

The purpose of a test event is self-assessment and its result may be used for adaptive instruction. A test event is similar to a practice event, but hints and feedback are not provided and it is always system controlled. A test event grades every problem and provides a summary of the test result for the student. The types of the problems in a test event are the same as those described in section 3.3. The test may be adaptive.

Parameters of a test event may include difficulty level, amount of problems, and adaptation. Difficulty level is the average difficulty level of all problems. Amount of problems is the number of problems to be included in the test. Adaptation determines if the test is adaptive or not.

Authoring A Course Using Instructional Event Shells

Authoring a course using ConceptAuthor consists of the following three phases.

- Content knowledge acquisition
- Course structure construction
- Instructional event configuration

Content knowledge acquisition is to build concept taxonomies and enter the concept name, the concept definition, the concept context, and a list of concept characteristics, lists of discriminans, the concept instances, and the problems for each concept in the taxonomies. Course structure construction is to create the tree structure of a course and define all course units including instructional events. Instructional event configuration is to associate instructional event with the content knowledge (concepts) to be taught and set values of all parameters of an instructional event. ConceptAuthor includes a set of tools to assist the course developer in all these three authoring phases. Part of the course structure construction phase and the instructional event configuration phase could be automated. In this section, we will not discuss the authoring processes of these three phases and how these tools work. Instead, we will concentrate on the discussions of how instructional event shells can be used to formulate different concept teaching strategies (Merrill, et al., 1992). Many different concept teaching strategies may be created using the four instructional events. We will only discuss a few of them.

A typical and conservative strategy is the sequential strategy that teaches one concept after another. The instructional sequence for teaching one concept is *introduction*, *demonstration*, *practice*, and *test* (Merrill, et al., 1992). Coordinate concepts should not be taught one-by-one and should be taught simultaneously so that similarities and differences of these coordinate concepts may be compared. One strategy for teaching coordinate concepts is the sequential-simultaneous strategy that introduces and demonstrates all coordinate concepts one-by-one and practice and test on all coordinate concepts simultaneously.

An alternative strategy for teaching coordinate concepts is the simultaneous strategy in which all coordinate concepts are introduced, demonstrated, practiced , and tested simultaneously.

The last strategy discussed in this section is the discovery strategy that is very different from previous introduced strategies. The discovery strategy facilitates learning by discovery. It guides the student to discover the definition of the target concept by presenting a sequence of examples and counter examples of the concept. The order in which these examples and counter examples are presented should be well designed. After one or more examples and counter examples are presented, a few problems may be asked to check how well the student learned by discovery. And then, more examples and counter examples may be demonstrated again, and a few more problems are asked. This discovery process repeats until the student discovers the concept definition or the student quits this process. After this discovery process, the concept definition is presented followed by a test. Similarly, the discovery strategy can be sequential and simultaneous. The discovery strategy discussed above is sequential.

Conclusion

In this paper, we reported the work we conducted in development of a concept teaching authoring system, ConceptAuthor. This work is a part of a larger project. One of the objectives of development of ConceptAuthor is to explore the methods for developing authoring systems to support content-based authoring. The second objective of this work is to investigate methods for automating instructional design of adaptive instruction using instructional event shells. ConceptAuthor is being implemented on Windows 95 in Visual C++ and Access.

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Enhancing Cognitive Skills of Hearing Impaired Children with 3DRotating Objects in Virtual Reality

David Passig
Sigal Eden
Center for Educational Technology
Bar-Ilan University
Israel
passig@mail.biu.ac.il
ueden@trendline.co.il

Abstract: The deficiency of the auditory sense in the hearing impaired raises the question as to what extent this deficiency affects their cognitive development and intellectual abilities. In studies that have been carried out over the years, many theories have been presented on the cognitive development and performance of hearing impaired. The purpose of this study was to discover whether the practice of rotating three-dimensional objects with Virtual Reality will have an effect on the flexible thinking in hearing impaired children. The study was carried out with 60 children, of which 44 were hearing impaired. The hearing impaired children were distributed into two groups: the experimental group and the control group. The experimental group played virtual 3-D "Tetris" individually, for 15 minutes, once a week over a period of three months. The control group played 2-D "Tetris" over the same period of time. In addition, 16 children with normal hearing took part in the study as a second control group in order to establish whether hearing impaired children really are at a disadvantage in terms of their flexible thinking. The experimental group and the hearing impaired control group were evaluated by the Torrance sub-test "Circles" (1966), before and after the experiment. The results clearly indicate that practicing 3D spatial rotations with VR significantly improved the flexible thinking in the experimental group as opposed to the hearing impaired control group, who did not improve significantly. Also, before the experiment, it was discovered that the hearing impaired children attained lowers scores in flexible thinking than the children with normal hearing. After the experiment, however, the results of the experimental group improved to the extent that there was no noticeable difference between them and the control group of children with normal hearing.

Introduction

The concept of "creativity" is regarded and defined in different ways by different researchers. The definitions differ from each other according to the difference in their approaches to creativity. In general, one can divide the definitions into three categories (Nevo, 1997):

1. The definitions which emphasize the creative process.
2. The definitions which deal with the creative person and his/her personality. These definitions focus on inter-personal differences such as the characteristics of the creative person and how s/he differs from the "regular" person.
3. The definitions which deal with the product. They emphasize the realization of the potential of the main idea and the extent to which the final product differs from that which already exists.

The approach of Guilford (1967, 1970) and Nevo (1997) has been of great influence. They refer to factors in activating and factors of character, but their main contribution is in the detailed analysis of the elements found in the process of creative thinking. According to their approach, creative thinking is a complex and diversified phenomenon and it involves a number of capabilities which are almost independent of each other. Guilford distinguishes between a) convergent thinking b) divergent thinking.

Convergent thinking points to the production of information emphasizing one single probable and best result. On the other hand, divergent thinking flows in many different directions and is connected to thinking functions in which there is not just one correct solution. This way of thinking is also known as creative thinking. Guilford identified four factors related to the ability to think creatively:

* Fluency—the ability to think of a number of possible solutions to a given need.
* Flexibility—the ability to change approaches and points of view, and not stick to only one approach.
* Originality—the ability to arrive at new and unconventional solutions.
* Elaboration—the ability to develop and improve basic ideas.

Torrance (1980) points out that most young children are creative, but that this ability wanes as they mature. Schools teach with conventional methods, which focus on precision, speed and the provision of correct answers. There exist specific teaching programs which attempt to develop creative skills using various activities such as: brainstorming, creative drama, activities related to creative art, unconventional uses of daily objects, etc.

This study focused on the child's ability to think flexibly (the second aspect of creativity described by Guilford (1967, 1970) above). Sternberg & Powell (1983) define flexible thinking as the ability to look at things from different angles. They point out that during adolescence the ability of the child to think flexibly is more prominent. This flexibility is expressed in two opposite directions. On the one hand, children exhibit better ability to think consistently and adhere to methods which proved effective in solving problems. On the other hand, when necessary, they are capable of changing their work methods and exchanging them for more successful methods. Flexible thinking is one of the most important characteristics of intelligent behavior.

Guilford (1967, 1970) claims that flexible thinking is the ability to create a flow of ideas while changing direction or correcting information. In his opinion, there are two types of flexibility a) spontaneous flexibility—spontaneous change in the thinking process and the transition to another, and b) adaptive flexibility—the ability to adapt to changing instructions. The component of flexibility appears to Guilford to be related to the ability to generalize and abstract.

Researchers studied the ability of hearing impaired children to think flexibly both verbally and in terms of shapes. This study relates solely to non-verbal ability.

Laughton (1988) compared the traditional approach of teaching art to teaching programs geared to developing creative ability. He studied 28 hearing impaired children between the ages of 8-10, who took part in one of the two programs for twelve weeks. The children were tested in the Torrance formal test before and after the intervention. It was found that there was a significant improvement in flexibility and originality among the children who studied according to the new program. Laughton (1988) summarizes and claims that by means of the appropriate teaching strategy it is possible to develop creative aptitudes with hearing impaired children and to help them to become less concrete and rigid in their thinking.

Saraev & Koslov (1993) examined 100 deaf children and 164 hearing children between the ages of 7–12. One of their findings shows lesser ability in creative imagination among the deaf, and rigidity in their way of thinking.

King & Quigley (1985) also claim that hearing children surpass hearing impaired children in creative ability.

The teaching of art usually receives lower priority than academic subjects in the teaching programs for the hearing impaired. Researchers have found that focusing more on strategies for creative thinking will have a favorable effect on:

a) abstract thinking,
b) imagination,
c) the attention paid to various details of patterns whose basis is visual but which can basically serve as linguistic behavior,
d) potential emphasis on the creation of vocational opportunities,
e) more efficient functioning in situations requiring the solving of problems, etc, (Laughton, 1988).

Bunch (1987) also claims that teachers tend to concentrate on the areas in which the hearing impaired experience the most difficulty—the language, communication and reading. Studies show that the hearing impaired lack the aptitudes required for artistic development. Bunch claims this is not due to lack of potential, but rather the lack of opportunities to develop the potential required for these aptitudes. In his opinion, if these pupils are given the opportunity to develop their potential and the teachers are provided with methods of encouraging creative thinking, hearing impaired children will progress and reach the level of hearing children. He perceives music, dance, drama and visual art as creative tools which can be used to develop language and cognitive skills such as: problem solving, abstract thinking, clarity of thought, developing imagination, etc. Upon examination of various teaching programs, Bunch found three basic goals for the teaching of art to hearing impaired children: strengthening visual awareness; developing pre-artistic abilities; developing imagination.

In recent years, one can notice an active approach of intervention in the cognition of the deaf, in an effort to improve their intellectual functioning. At the root of this trend is the belief that deaf students possess the same range of intellectual potential as hearing pupils. They can reach this potential if their environment, their instruction and the tools employed are appropriate and encourage learning. In addition, the researchers leading this approach point out the great importance of intervention programs for the improvement of the cognitive achievements of the hearing impaired (Gruler & Richard, 1990; Huberty & Koller, 1984; Martin, 1991).

Many other researchers note the close link between creativity and imagination. The ability to imagine and transform images is important in many areas, including creativity (Kaufman, 1985; Kosslyn, 1980; Shepard & Metzler, 1971). Singer (1966) found in his study, that children with developed imaginations were more creative than children with poor imaginative ability. That is to say, the ability to imagine different scenes and animals, the ability to deal with a wide range of changes and imagined transformations and the ability to be flexible in thought—all indicate a tendency toward creativity.

Studies have thus proven that hearing impaired children tend to be more concrete and rigid in their thought processes. They usually choose one familiar means of solving problems and use it to deal with most of the problems that they encounter. The purpose of this study was to prove that it is possible to improve the flexibility of thinking in hearing impaired children with the help of a cutting edge technology—Virtual Reality (VR).

Pantelidis (1995) defines VR as an interactive multimedia environment, based on the computer, in which the user is assimilated into, and becomes an active participant in the virtual world. This technology can present information in a three dimensional format in real time so that the user becomes an active participant in the environment which communicates interactively without the use of words. VR makes it possible to convert the abstract thinking into more concrete by providing a perspective on processes which is not possible in the real world (Darrow, 1995; Durlach & Mavor, 1995; Osberg, 1995; Pantelidis, 1995).

Virtual Reality is a new thinking tool which can be used without language, and it might become an appropriate work tool for hearing impaired children.

Subjects

A pilot study was carried out, in order to validate the Virtual Reality game as a research tool. The pilot study included 10 hearing impaired children, who achieved an average score of 4.2 out of a possible 100 points.

The study examined 44 hearing impaired children between the ages of 8-11 (average age 9.3) who had middling to severe hearing loss, with an average hearing loss of 88.62 dB. They had no additional problems. The children studied in integrated classes in the only two schools under Ministry of Education supervision in the central/ Tel Aviv school district. In these schools hearing impaired children study in small separate classes, but take part in general school activities and are integrated into some of the classes together with hearing children.

In addition, we chose 16 hearing children in order to establish whether hearing impaired children do achieve poorer results than hearing children, in their ability to think flexibly. The ages of the hearing children ranged from 8-10 years old (average age 8.8). The sample included a total of 60 children according to the following divisions:

* 21 hearing impaired children served as the experimental group.
* 23 hearing impaired children served as the control group.
* 16 hearing children served as an additional control group.

Procedure

Each subject in the experimental group played, on his own, a 3D Tetris game, once a week, for 15 minutes, over a period of three months. The hearing impaired control group played, during the same time period, a 2D Tetris game. The control group of the hearing children did not experience any intervention at all.

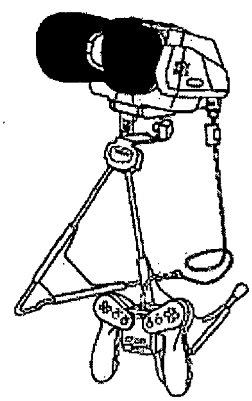
The experimental group and the hearing impaired control group were tested before and after the intervention in the sub-test "Circles" – Torrance (1966). This test was used in order to study whether practice in the rotation of three dimensional objects, which requires the ability to view objects from different angles, will have an influence on the flexibility of thinking in the subjects. The test includes verbal and non-verbal tasks. We used the non-verbal tasks owing to the verbal insufficiency of the subjects. This test has been carried out many times over the years and has received the high score of 90 in reliability (Torrance, 1966).

The instructions for the test were given orally, accompanied by the use of sign language, in order to ensure that all the children understood them fully. The hearing children were tested only once.

Virtual Boy – Nintendo

The game used in this study is an interactive VR game, with a distinctive system which can create a dramatic three-dimensional world. The software included three games (Tetris, Puzzle, Center-Fill), in all of which the objective was to carry out certain demands via control over three dimensional blocks: the subject had to fill a three dimensional block with various shapes made up of smaller blocks. The subject had to put the dropping blocks in the right place, and accordingly, accumulate points. In order to accumulate more points, the user must act accurately and rapidly. This three dimensional VR game presents to the user many ways of solving the problem. Because of the variety and quantity of possibilities, it is usually not possible to remember exactly how the problem was previously solved, and the user solves the problem placed before him differently each time he plays the game. Thus he learns that there are many and varied solutions.

Figure 1: Virtual Boy- Nintendo 1995



Results

The research suggested that a clear difference would be found between the experimental group of hearing impaired children and the control group of hearing children in their ability to think flexibly before practicing spatial rotation, by means of the VR game. After the practice, in contrast, the ability to think flexibly improved in the experimental group to such an extent that no clear difference was found between this group and the control group of hearing children. That is to say, the scores of the hearing impaired children in the experimental group were similar to those of the hearing children in this test. In order to verify this, we conducted a one-way analysis of variance.

Table 1 presents the averages in the measurement of flexibility of thinking in the three research groups–the experimental group of hearing impaired, the control group of hearing impaired and the control group of hearing children, and the analysis of the variations among the groups.

Table number 1: Results of the one-way variance test for the calculation of averages, standard deviation and variance analysis of flexible thinking by research groups (experimental, control hearing impaired and control hearing) and by time.

Time		HI experimental	HI control	Hearing control*	Model P,F	Group P

Before	Average	7.05	5.91	23.00	F(2,57)=177.92 P<0.001	P(1,2)=n.s. P(1,3)<0.001 P(2,3)<0.001
	Standard Deviation.	2.85	3.50	2.37		
	Sample Size	21	23	16		
After	Average	18.10	5.96	23.00	F(2,57)=102.04 P<0.001	P(1,2)<0.001 P(1,3)<0.001 P(2,3)<0.001
	Standard Deviation.	5.76	3.47	2.37		
	Sample Size	21	23	16		

- HI= Hearing Impaired.

* Comment: the control group of hearing children took the tests once only; that is to say, the data in the table was copied from "before" to "after".

Figure 2 presents the average scores in flexible thinking of the three research groups – experimental, control hearing impaired and control hearing, before intervention.

Figure 2: Averages of flexible thinking according to research groups before intervention

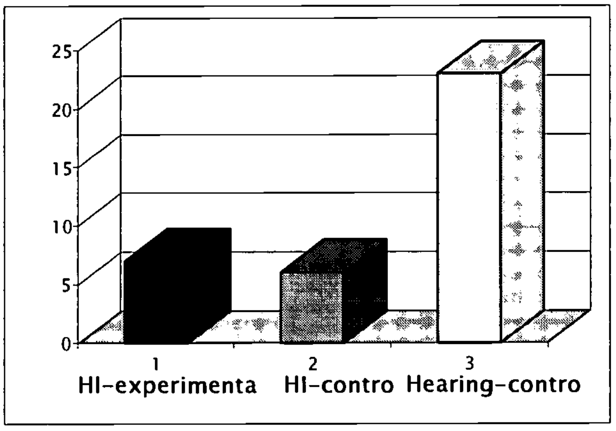
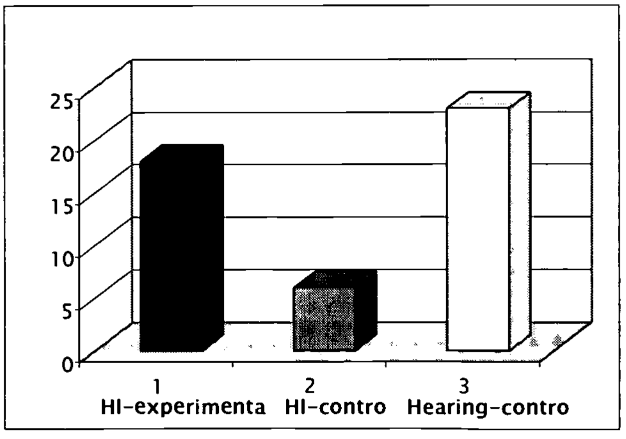


Figure # 3 shows the averages in flexible thinking measured after the intervention.

Figure number 3: Averages in flexible thinking according to research groups after the intervention.



A look at Table 1 and Figures 2 and 3 indicate that prior to the practice there was a considerable gap in flexibility of thinking between the research group of hearing impaired children (both the experimental group and the control group) and the control group of hearing children. The difference favored the hearing children. No considerable difference was found between both research groups of hearing impaired children (experimental and control groups). In contrast, after the practice, a clear difference was found between the experimental hearing impaired group and the hearing impaired control group in their ability to think flexibly, favoring the experimental group. No clear difference was found between the experimental group and the control group of hearing children; that is to say, the children in the experimental group improved their achievements significantly and reached the level of the hearing children in this index.

Discussion

One of the goals in the education of hearing impaired in Israel and throughout the world is the emphasis on the importance of nurturing thinking in these children. Studies have found that the functioning of the hearing impaired improved after appropriate learning, training and practice (Gruler & Richard, 1990; Martin, 1991). In addition, the existing programs of intervention do not exploit the vast possibilities of modem technology, especially the modem, attractive technology - VR. This study is unique due to the use it makes of the virtual game, which trains in spatial rotation as a means of improving flexibility of thinking in hearing impaired children. To the best of our knowledge, this is the first experiment of its type to exploit the advantages of VR technology, and of this game specifically, as a means of intervention for nurturing the cognitive skills of the hearing impaired population.

This study found a clear difference in the ability to think flexibly between hearing impaired children and hearing children before practicing, to the advantage of the hearing children. This finding is reinforced in previous studies which found that hearing impaired children possess lesser ability in creative imagination and have a tendency to rigidity in their thinking (Saraev & Koslov, 1993). After practice, the children in the experimental group improved in their ability to think flexibly with the help of the 3D VR game, and no marked difference was found between them and the control group of hearing children. In contrast, the control group of hearing impaired children continued to score poorly and the gap between them and the hearing children did not narrow. In other words, the hearing impaired children who played with the VR game reached the level of the hearing children. This finding parallels that of Bunch (1987) who claimed that if hearing impaired children are afforded opportunities to develop their potential and the teachers are provided with methods of encouraging creative thinking – hearing impaired children will progress and will reach the level of hearing children.

The results indicate a clear advantage of 3 dimensional VR (received by the experimental group) over the conventional 2 dimensional intervention (received by the hearing impaired control group). It is reasonable to assume that these findings were obtained due to the differences between the two types of practice. The children in both groups played, during the same period of time, rotation games via Tetris, with only one difference between the two groups – 3D VR versus a 2D game.

A logical explanation of these findings is found in the nature of VR technology and in earlier studies. This technology creates a "pre-symbolic" form of communication, and its users can communicate with imaginary worlds without the use of words. Thus, a world is created charged with sights, voices and sensations which surpass syntax and language (Passig, 1996). The hearing impaired children who used this technology were able to realize their hidden potential without linguistic or auditory limitations. VR technology does not limit the player in either the manner in which information is presented or in his movements, and the user is able to immerse himself in the learning environment (Pantelidis, 1995). In this virtual manner, the hearing impaired users completely immersed themselves in the game. They felt as though they themselves were moving the blocks, searching for the right ones and rotating them. In other words, the abstract became less vague and more concrete. Various studies in the field of VR also found that this immersion serves to broaden the interface with the senses and also improves the ability to understand abstract concepts by converting them to more concrete ones (Darrow, 1995; Osberg, 1995). Another unique quality of the technology is that VR causes the user to be especially active. The increased liveliness and level of interactivity causes the user to become a part of the virtual world. This tool is able to present information in three dimensions and in real time. This permits the user to be an active participant in the environment and not merely a passive observer (Bricken & Byme, 1992; Heim, 1992; Osberg, 1995; Powers & Darrow, 1994). Hearing impaired children require more active involvement in the learning process than hearing children (Marzam, 1998).

Another fitting explanation of these findings is the fact that this technological tool is fun and motivates the user. Studies have shown that children who use VR enjoy it and wish to continue to learn more by using it (Bricken & Byme, 1992; Talkmitt, 1996). It would appear that the high level of motivation of the children studied led to their continued participation in the intervention program and their success in it.

Summary

This study proved that a significant improvement in flexible thinking took place in hearing impaired children due to the use of a 3D virtual reality game. Beyond this contribution, important in itself, the biggest contribution is the advancement of this field to the point where hearing impaired children reached the level of hearing children. In the light of the findings of this study, and its low cost, we recommend that schools in which hearing impaired children study, purchase this hardware and software.

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ISTOPOLIS – A network based hypermedia educational system

C. M. Papaterpos, G. D. Styliaras, G. K. Tsolis, T. S. Papatheodorou
High Performance Computing Lab,
University of Patras, Rion 26500, GREECE
{cmp, gds, gkt, tsp}@hpclab.ceid.upatras.gr

Abstract: Web based technologies and efficient techniques on the LAN and the desktop, can be combined for the development of a single modular and scalable educational system, capable of adopting to and functioning in different learning environments: stand-alone use, use in a LAN enhanced classroom and distance learning on the Web. Such a system is presented in this paper. The design of the system addresses well-defined educational and pedagogical goals and attempts to facilitate different computer cognition levels. The current implementation demonstrates the use of the system with educational material designed especially for teaching Ancient Greek History to 7th grade students.

1 Introduction

ISTOPOLIS is a hypermedia based educational system initially designed for courses in history, culture and related fields. Emphasis has been placed on deployment of the system in the classroom. The design of ISTOPOLIS attempts to address fundamental educational issues and goals, including transformation of available information into knowledge, practicing basic skills and dealing with low and / or highly variable computer cognition level on the part of the students.

The system provides its users (educators, students and content providers) with a broad set of services over media-rich educational material, in a highly configurable manner. The material used may cover many different knowledge areas. Educational material is presented to the end user in the form of hypermedia documents. Each document covers a small subsection of the target knowledge area and constitutes an information item. The collection of information items offered to the user follows a concrete data organization scheme. Efficient access to the document base is facilitated through different views of this organization scheme. Each view is implemented as a highly interactive access tool, which not only helps the user locate documents, but also places the documents within specific contexts, leading to a better comprehension of the material. These views include a thematic categorization, geographical and chronological navigation systems, and a simple to use search facility. It follows that the content of the system consists of a set of independent and multiply structured information items that users can access. Additional content may be accessed from related web sites.

Access to the information items as well as to these tools may be provided to the end-users either through a standard web browser, or through a specialized client. The client, apart from access to the content, enables all users to compose projects (small sets of hypermedia documents in the form of an essay) by reusing parts of the content. Additionally, it enables teachers to create their own views of the content (in the form of guided tours) and teachers and students alike to playback these tours. Finally, the system provides teachers with a tool for creating and grading tests. Each test can incorporate different types of questions and can be completed and submitted on-line by the students. Access to the system is controlled through a server-based mechanism that authenticates users and assigns them their respective workspace.

Many of the services built in the client and the server are by now well established services and are very popular for accessing Web content. Innovation of this system lies in the way that these services interrelate and integrate into a single system, with a unified front-end for the end-user. Porting to other languages is straightforward and an English version of the system is now under development.

2 Pedagogical and educational issues and how they are addressed

There is a great number of pedagogical and educational issues regarding multimedia educational software. In this section we place emphasis on some essential requirements, particularly in the context of "human sciences" and junior high school students. We also discuss ways in which ISTOPOLIS addresses these issues (Papatheodorou, 1998).

2.1 Transforming Information into Knowledge

An important goal in developing an educational application is transforming information into knowledge. According to (Rohrs, 1984), students should be allowed to express "their creativity, one of the most essential goals in education", while the goal is not to "turn students into small libraries but to allow them to take active part in the process of knowledge" (Bruner, 1975). It is also well established that notions are not conquered by students through definitions, but through experience and "trial and error" techniques (Vygotsky, 1962).

Addressing this goal is based on the use of a set of information retrieval tools (Access Tools) that do not only enable the user to locate information (such as in a search system), but, at the same time, place the information within complementary contexts (time, place and subject). The Access Tools are coupled with a facility for the students to reuse located information, combine it with their own narration and personal views and transform it into small essays.

2.2 Practicing basic skills

Some of the most important skills that students should practice are briefly discussed below, together with the ways that ISTOPOLIS attempts to accentuate them. Most of these skills are of particular significance in the case of humanities and especially history (Curtis (1994) and Culpin (1994)). Successful practicing depends both on system qualities and on the way the software itself is used within and outside the classroom, during and after normal teaching hours.

Working alone and within a group. It is essential that students learn to "work as a team" in order to be "able to adapt in a continuously changing world" (Rohrs, 1984). ISTOPOLIS allows students to work in groups by letting teachers assign a unified workspace to students belonging to the same working group. In this workspace, projects may be collectively developed. A student may also use the system individually, either in classroom or at home, since the system can also operate in standalone mode. Moreover, students or groups may exchange pages or bookmarks on pages via email.

Identifying reliable information and distinguishing between facts and opinions, evaluating sources and selecting related information from a variety of sources. ISTOPOLIS enables students to develop projects, using information available locally and on the Web. This way, it offers access to a great variety of sources, which deviates from the common single textbook approach. Material provided with the application is developed and tested by experts and can be a-priori considered reliable. The fact that this information follows a common presentation template makes it visually different from work produced by other students as well as from other material gathered through the Web.

Understanding of terms. Terms that the students are anticipated to be unfamiliar with are visually marked on the screen. Explanation of a term is given as a popup activated by placing the mouse pointer over the term. Elaboration of more significant terms is provided in related pages within the educational material.

Locating and recalling information. ISTOPOLIS places the content within specific time and place contexts and provides clear thematic categorizations, thus offering considerable assistance in locating and recalling interrelated information. Recalling information is accomplished through the same tools students use to locate the material.

Describing, narrating, interpreting, comparing, drawing conclusions from information contained in texts and expressing opinion. Through authoring a project, students are given the chance to combine various tasks, such as composing and serializing facts presented within the educational material, narrating or describing situations and facts and expressing their own views. Comparison of information pieces found in the material is made easier by the fact that these pieces may be very easily inserted into the student's project.

2.3 Computer cognition issues

Some important issues involve the computer cognition level of the targeted users. One issue is the low level of familiarity with computers for the majority of students, especially in low-income cases and rural areas.

Thus, an important requirement is that the system is easily useable by inexperienced users as well. In addition, it should help users to acquire and practice standard computer operation skills through a widely used environment and user interface. A second issue is the large difference in computer cognition levels among students in the same class. The problem is more evident in urban environments where, among inexperienced students, there are a few with strong computer experience. The system should attempt to provide "equal opportunity" for all.

One approach that ISTOPOLIS uses to deal with these issues is to offer different modes of operation, corresponding to different levels of computer experience. The simplest way for a student to use the system is through the *guided tour* operation mode (sequential navigation through a series of "pages" selected by the teacher from the educational material available). In a higher mode, the system provides the option for the student to customize his/her own exploration of the educational material. This is accomplished through hyperlinks embedded in the content and deploying the *Access Tools* described in the next section. In this mode, the student is required to take actions that are normally met in common Web browsing activities. In a third mode, the student may reuse portions of the educational material and compose his / her own hypermedia documents. This process involves basic word processing skills and use of drag' n' drop operations. The teacher may decide on the use of any combination of these modes, according to the level of the classroom.

Another way in which ISTOPOLIS attempts to deal with these issues is through a simple-to-use, consistent user interface. Browsing and authoring are implemented by integrating a common Web browser and a word processor. Thus, the user of the system is assisted by and assists training in such basic tools. Access to content and services is provided through a unified workspace, implemented by a specialized client designed as a single-document interface (SDI) application. The user is not required to wander through windows or switch between different applications and confusion between application oriented and content oriented operations is largely eliminated.

An additional issue strongly related to the user's experience is the use of navigation tools. In hypermedia-based systems, the need for navigation-aiding tools complementary to following embedded hyperlinks is practically self-evident (Christodoulou, 1998). Several tools that are based on navigation structures have been proposed (Schwabe 1995). Initial findings indicate that inexperienced users under-utilize navigational tools based on high levels of abstraction e.g. concept-maps (Zeiliger, 1997). Tools based on structures and models with which students are not familiar (e.g. graphs) would increase the cognition overhead required to exploit these tools. Instead, ISTOPOLIS provides access to multiply structured information through simple navigation tools (e.g. maps), consistent with the students' experience.

2.4 Other issues

Teacher related issues. ISTOPOLIS supports teachers in various stages of the educational process, such as presentations and student evaluation. The teacher is provided with the ability to instruct students to browse through the content or follow a guided tour. ISTOPOLIS enables the teacher to make additional content available to the students through the system, by authoring and publishing his/her own projects. Evaluation of students' performance is assisted through online inspection of student projects, facilitation of test development and online test grading.

On-line / off-line operation. A user may autonomously use the system from home with or without an Internet connection (stand-alone or on-line operation).

Updating the content. In the current implementation, updates of the content and of basic customization of the Access Tools are supported. This includes re-indexing of content for the search system, changes on objects that appear on maps, addition of thematic categories, etc.

3 Functional specification of the system

Users of ISTOPOLIS may be classified into end-users (teachers and students) and content providers. The system may be deployed in the classroom LAN, over a wide area connection with a remote server, or as a stand-alone application. ISTOPOLIS offers two fundamental services and a complementary one for end-users, which constitute the end-user segment of the system: locating educational material; reuse of material for creating projects; and creating and conducting tests. A back-end subsystem, ("preparation segment"), allows the content provider to enter the data and customize the functions that enable end-users to locate material.

The system is based on educational material presented to the user in the form of hypermedia documents, each document being an autonomous information item. Apart from the content provided with the system, the user may access HTML pages from the Web.

The easiest way for students to access information is through a guided tour created by the teacher. In this mode of operation and by using a small set of buttons, the student can sequentially navigate through a series of content pages arranged by the teacher. The teacher can locate the information to include in the guided tour by using the Access Tools described below and can create the guided tour through the use of a pertinent tool incorporated in his/her workspace. The user can leave the guided tour and browse the content through embedded hyperlinks and the use of Access Tools and return to the flow of the tour by clicking a button.

Access Tools presently include four basic tools available to the end user and are briefly outlined as follows. All information items are associated with keywords and are loosely classified according to three basic classification criteria: time, place and subject. Data directly related to the content (such as title, text, images and keywords) as well as fine and coarse-grained classification data follow a single, simple and concrete data organization scheme. This makes it possible to present three different views of the content as main branches of a subject catalogue. The subject catalogue is implemented as an Interactive Thematic Catalogue (ITC) system described in (Styliaras, 1998). For the chronological and geographical classifications, both a coarse-grained (based on eras and greater areas) and a fine-grained (based on years and specific map coordinates) characterization of content is given. Fine-grained classifications are used to support access to the chronological and geographical views through visual tools: a timeline and a map-based navigation tool. All three tools, subject catalogue, timeline and map-based tool, support searching or filtering. Map-based navigation provides filtering based on time and subject related criteria. Finally, keywords correlated with the educational material are used within a search tool that apart from searches on sets of keywords allows for full text searches on the material.

The specific chronological, thematic and geographic context of each information item is exposed to the user as a hyperlink to the corresponding category. Exposing the context of each information item in a typical fashion helps the user recall the information at a later stage (e.g. when authoring a project). Using a hyperlink to the corresponding categories (and tools) enables the user to locate relevant information within specific context.

Customization of the classifications and data entry of the actual educational material is achieved by the "content provider" through a back-end subsystem (preparation segment). Data entry for the system is carried out at the same time for all four tools. Update of a single piece of information automatically updates the behavior of the Access Tools. It should be stated that the content provider need not be confined in the three classifications chosen for the current implementation of the system. In order to facilitate use in different knowledge domains, creation of various classifications is possible for the content provider through the back-end environment.

Reuse of the educational material is achieved within the *specialized client* through storing material and incorporating it into a *project*. The user can store text excerpts, images, bookmarks and hyperlinks. Storing a part of information is implemented through a simple process, which consists of selecting the information item, dragging it and dropping it onto the client's inventory area. Bookmarks are stored in the same way, by selecting and picking up a control next to the page's title. All items in the inventory area are represented by icons. Users may store bookmarks or material not just from the content provided with the system, but also from any HTML page on the Web, exploiting thus a variety of sources.

A project is organized in pages, which are represented by icons in a page-index area. To insert a piece of text or an image, the user selects a page in editing mode (preview of pages is also supported), drag the icon of the text or image and drop it onto the page. Users may create hyperlinks by selecting the source of the link on the page being edited (text or image) drag a link or a bookmark from the inventory or a page of their own from the page index and drop it on a "link creation target area". When editing a page, users can write their own text, modify the text they have included and, of course, write their own text. To keep use of the system simple, a small set of editing functions is provided: it includes character and paragraph formatting and application of predefined styles that help the user translate contextual information (such as project or page heading) into visual (different but concise visual formatting).

A brief overview of the overall architecture and system building blocks is presented in Figure 1. Content and access tools, guided tours (creation and playback), project authoring and publishing and completion of tests are available to the user through a specialized client that, among others, incorporates functionality of a web browser and an HTML Editor. Separate (for the current implementation) tools facilitate creation of tests and support the content preparation and Access Tools customization process. Content and access tools may also be available to the user through a conventional Web browser. In the current implementation, some of these functions are offered only for Microsoft's Internet Explorer.

Within the client, services offered are grouped into operating modes, with varying levels of difficulty, so that the teacher may fine-tune system deployment. *Free navigation* offers use of the Access Tools, bookmarking and tests. *Guided tours* offer all Free navigation services, plus a guided tour creation tool for the teacher and a guided tour playback tool for the students. *Project authoring* offers all free navigation services, plus all operations needed for authoring projects.

The system generally follows the client-server paradigm. The content resides on the server side. The data organization scheme for the content is supported by an RDBMS, over which the Preparation Segment of the system has been built. The biggest part of functions (including the Access Tools) is also implemented on the server side. In order to offer additional services to the teacher (creation of guided tours and tests) the system requires that the user be authenticated. This process authenticates registered users of the application, as either teachers or students (implying different functionality of the client) and as members of specific working groups in the case of students. The process assigns a working area in which users store their work. The relative location of the client and server part of the system determines whether the system is used 1) over a LAN, 2) over a remote connection (on-line), or 3) as a stand-alone application (off-line). Special care has been taken so that the system may be easily reconfigured and used in other languages: most of the reconfiguration needed may be carried out through simple changes on resource files.

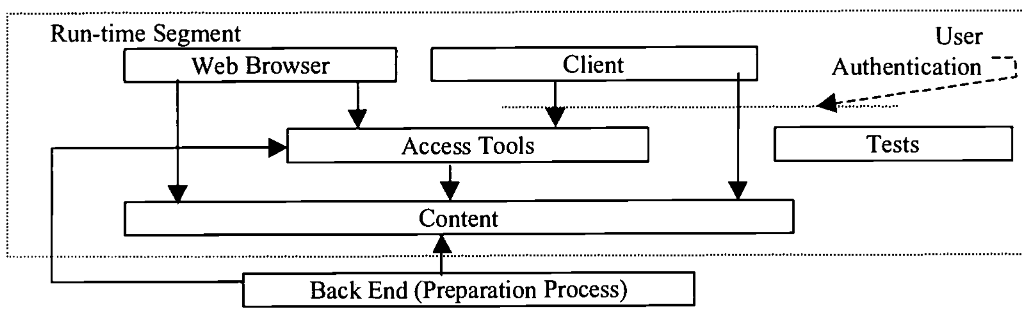

Figure 1: Architecture of ISTOPOLIS.

4 Current implementation details and evaluation results

All building blocks, demonstrated in Figure 1, have been implemented and integrated into the system, which is fully operational. The current implementation has focussed mainly on the system's operation in class. The available content is presently targeting 7th grade students and covers about 450 information items from Ancient Greek History (specifically the Palaeolithic period to 1125 B.C.). For implementing Web browsing and project-page editing functionalities, Microsoft's Internet Explorer and Word 97 have been integrated within the system. Architectural and implementation details may be found in (Papaterpos, 1999). Figure 2 displays how the client looks like in project-creation mode, while a user is locating information through the map-based navigation tool. A list of the projects' pages appears in the left of the screen. The inventory, where chunks of text, links and images are collected, appears in the bottom.

Currently, the system is undergoing a systematic on-site evaluation in a set of Greek High schools. It is expected that the on-site evaluation will be concluded early next year and detailed evaluation statistics will be available at that time. Preliminary in-house testing with students and teachers seems to validate achievement of most of the requirements set. Students relatively unfamiliar with computers easily adjusted to the gradually increasing levels of difficulty provided.

From the testing phase, some possible enhancements have emerged. For example, users would like to have more material from different sources. Furthermore, the backend should be made available to teachers in order to have the ability to add more material (found either on-line or from conventional sources). In this way, there will be no need for an expert content provider to insert the data into the system. Concerning the guided tours, an extra "presentation" view is needed, which will be more suitable for displaying the guided tour within the classroom. What's more, teachers should be given the capability to annotate pages included in the guided tour. Regarding the subject catalogue, more elaborate filtering could be applied to its categories. As it is expected that groups of students will use the system, a better collaboration scheme is needed for students working within the group, so that it won't be necessary for all students in the group to work simultaneously.

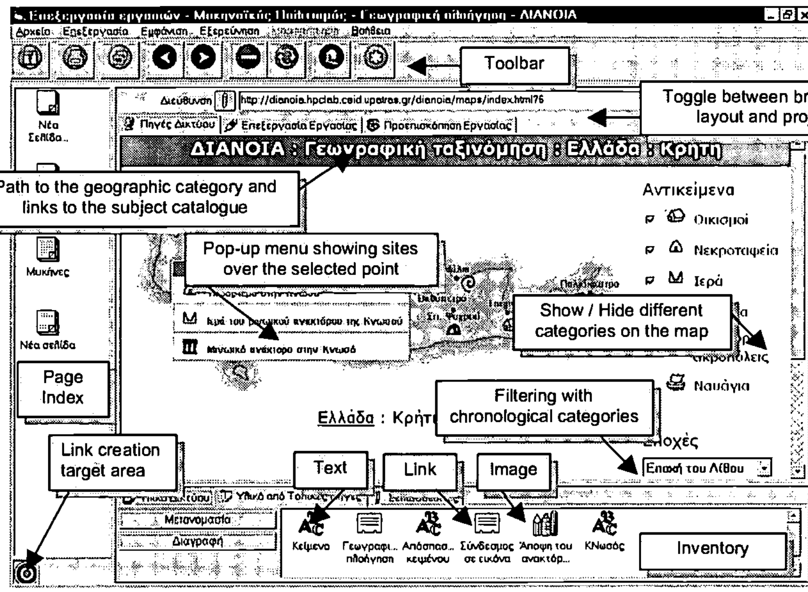

Figure 2: An instance of ISTOPOLIS in action

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Multimedia Goal-based Scenario for Learning to Diagnose Fetal Abnormalities

Yam San Chee, Ricardo Sosa, Eileen Tham, Sy Shyng Sng
School of Computing, National University of Singapore, Singapore
cheeys@comp.nus.edu.sg

Mahesh Choolani, Arijit Biswas
Department of Obstetrics & Gynecology, Faculty of Medicine, National University Hospital, Singapore

Kwok Chan Lun
Department of Community and Occupational Medicine, National University of Singapore, Singapore

Abstract: This paper describes an interactive multimedia learning environment for learning how to diagnose fetal abnormalities. The pedagogical approach adopted in the design of the learning environment is that of goal-based scenarios. The paper sets out the theoretical underpinnings of this approach and illustrates the learning environment by means of a typical system walk-through. It highlights some distinctive features of the system as well as pedagogical strengths of the learning environment. A critique of the learning environment is offered with respect to the criteria laid down for the design of goal-based scenarios.

Introduction

There is considerable evidence today indicating that the knowledge and skills of experts are highly situated and case-based (Kolodner & Jona 1991). This is especially so in the medical domain where expertise is often characterized as being data driven and is attained through exposure to a wide range of cases over long years of practice.

It is now also commonly accepted, especially in medical education, that students learn more effectively by directly participating in interactive case-based learning scenarios rather than by passive reading and observation (see, for example, Barrows 1985). Learning by doing has the advantage of providing for deeper engagement in the learning process and superior retention and transfer of knowledge. Thus, one would expect medical students to learn more effectively when given the opportunity to acquire clinical diagnosis and problem solving skills using the 'learning by doing' approach in a context-rich learning environment. In addition, experientially-grounded learning provides a concrete basis for subsequent reflection on a student's diagnosis and problem solving actions. Attempts to rethink and redesign learning experiences, especially technology-based learning experiences, occur as part of a broader and more fundamental shift in orientation within education (e.g. Schank 1993/1994) and also as part of a shift toward constructivist approaches to supporting learning (see, for example, Savery & Duffy 1995).

The training of medical general practitioners and medical students in the management of fetal abnormalities has always been a difficult matter in practice. This difficulty stems from the fact that:

a. fetal abnormalities in ultrasound scans of pregnant women are the exception rather than the rule
b. the repertoire of abnormalities that a student has the opportunity to experience firsthand is extremely limited
c. access to ultrasound scanning machines and training time on such machines for students is hard to come by because of general resource scarcity

To overcome the above difficulties, we have embarked on the development of a multimedia goal-based scenario for learning how to diagnose and manage fetal abnormalities.

Theoretical Background

A goal-based scenario is a case-based approach to learning. The approach requires instructors to design situated and authentic problem solving activities and domain contents. Within the goal-based learning environment, students are set specific problem solving goals. In pursuit of these goals, they perform tasks that help facilitate the acquisition of the target skills. In so doing, they also learn the underlying concepts upon which the target skills are based.

The goal-based scenario approach to the design of learning environments requires the designer to define a mission, a mission focus, a cover story, and appropriate scenario operations (Schank, Fano, Bell, & Jona 1993/1994). Briefly, the *mission* refers to the primary goal that the student pursues within the goal-based scenario. The *mission focus* refers to the overall organization of the student's activities within the goal-based scenario. Mission foci may be of different orientations, including design, discovery, exploration, and control. The *cover story* refers to the premise, designed by the instructor, under which the mission will be pursued. *Scenario operations* refer to the specific activities that the student performs in pursuit of a mission.

There are seven specific criteria that instructional designers need to consider when designing a goal-based scenario. These are:

a. thematic coherence: ensuring that the process of achieving the goal is thematically consistent with the goal itself
b. realism and richness: ensuring that the learning environment amply encompasses authentic tasks in context-rich settings
c. control and empowerment: ensuring that students are able to take control and feel responsible for the completion of the set task
d. challenge consistency: ensuring that the learning environment presents a consistent degree of challenge and difficulty over the entire process of achieving the goal
e. responsiveness: ensuring that time-critical elements of the environment occur in realistic simulated time, and providing prompt feedback
f. pedagogical goal support: ensuring that the learning scenario is compatible with and amply supports the acquisition of the target skills
g. pedagogical goal resources: ensuring that materials and tools needed to achieve the goal are available within the learning environment

In practice, the extent to which one finds it easy or difficult to achieve each of the above design criteria depends very much on the subject domain in which one is working.

Project Overview

Our research project has two main parts. The first part focuses on helping students learn how to diagnose fetal abnormalities. The second part focuses on training students on how to manage and counsel patients when abnormalities are discovered.

The first part of the project makes extensive use of ultrasonography. Ultrasound images of the unborn fetus are displayed to the user, typically a trainee gynecologist, on request. These images can either be digitized videos of ultrasound investigations or they can be still image "cuts" (i.e. cross-sections) of the unborn fetus at different body locations and orientations. Given the domain of diagnostic ultrasonography, we have made extensive use of multimedia and created a context- and media-rich learning environment where students are given control over what they wish to view or do at any point in time. When the user has reviewed the ultrasound images and the patient's case history to his satisfaction, he is requested to decide whether the unborn fetus suffers from any abnormality, and, if so, identify the type of abnormality.

Once the user has entered a diagnosis, the system makes an internal check to verify the correctness or otherwise of the submitted diagnosis. If the submitted diagnosis is incorrect, the system commences a sequence of interaction with the user. This sequence is designed to help him identify the cause of his mistake.

In the current state of the project's development, the rules that distinguish different abnormalities related to the Central Nervous System have been defined. These rules are stored in a database that the system refers to when trying to ascertain the correctness or otherwise of a student's response. At the same time, a media bank of images and video clips has been created for use as presentation stimuli. Much effort has been expended in designing and prototyping the interface of the system, with a special view toward task support and learning support.

The second section of the project focuses on the management and counseling of patients when a fetal abnormality has been correctly diagnosed. Work on this section has yet to commence.

System Description

The system presents users with the ability to perform "virtual" ultrasound investigations of women who are 24-weeks pregnant. This is a critical stage of pregnancy when abnormalities become identifiable. The goal-based scenario contains many different cases. Some cases have single abnormalities while others contain multiple, but mutually consistent, abnormalities. The system also includes normal cases; i.e.. cases with no abnormality. When a user first logs into the system, he is presented with the system splash screen. On dismissing the splash screen, the user is asked to log in and to enter his password. He can then choose:

a. to be presented with a randomly selected case from his set of unsolved cases
b. to be presented with a specific case based on the patient's medical history
c. to be presented with a particular anatomical system to investigate

The case selected by the user is then presented in the *Diagnosis* screen.

One of the pedagogical goal resources provided by the learning environment is the facility to compare the ultrasound scan presented by the system with a "normal" scan; i.e.. a scan of a fetus with no abnormalities. By clicking on the middle button on the bottom-right pane, a separate window showing a "normal" scan is displayed (Fig. 1).

The provision of this comparison facility is pedagogically driven. The comparison is very useful in helping users to disambiguate between critical features on the scan of a normal versus an abnormal fetus. Because part of the diagnostic skill being trained here is perceptual in nature, the provision of the contrasted images enhances a user's ability to identify and distinguish the contrasting conditions of a feature being examined. In addition to the normal scan facility, the system also provides the user with access to relevant medical terms and definitions and a list of diagnosis names.

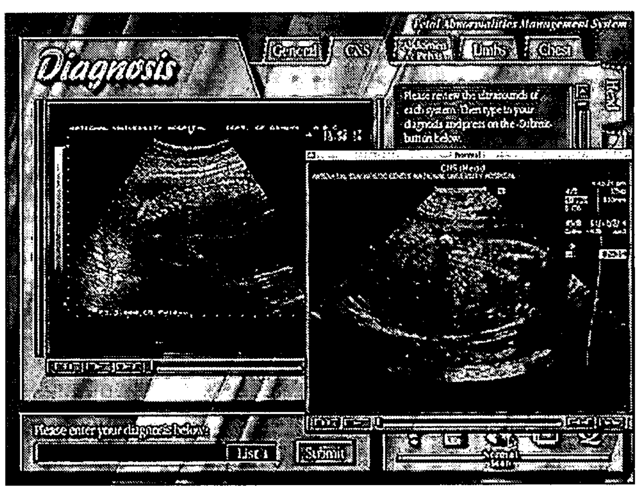

Figure 1: The Diagnosis screen with a “normal” scan comparison

As shown above, the user is able to explore all anatomical regions of the fetus by selecting the appropriate tab along the top of the window. These regions include the Central Nervous System, the Abdomen and Pelvis, the Limbs, and the Chest. Note also that certain regions are further divided into sub-regions: for example, the Central Nervous System is further divided into the Head and the Spine, as reflected in the sub-tabs on the right hand side. After the user has explored the images and scans of his choosing to his satisfaction, he enters his diagnosis in the dialog box shown in the bottom-left of the window. The system allows the user to either type in the diagnosis or make a selection from a pop-up list. We have provided alternative input methods so as to avoid, at least, initially, users experiencing difficulties over the correct spelling of the diagnoses. Once the diagnosis is made, the user clicks on the "Submit" button.

Suppose that the user enters a correct diagnosis: hydrocephalus. The system will then respond as shown in the following screen (Fig. 2).

Figure 2: System response to a correct diagnosis

As a separate pedagogical goal resource, the learning environment provides the user with an option to perform a systematic walk-through of critical features in the Central Nervous System that distinguish between a fetus with hydrocephalus and a normal fetus. Walking through the list of features helps students to imbibe an expert's diagnostic model and reinforces the user's understanding of the critical disambiguating features of the abnormality in question. The walk-through is depicted below (Fig. 3). As the user steps through the list of comparison features, he is requested to address each of the questions posed (e.g. "Is the bony calvarium present?") in the context of comparative images of a normal fetus and a fetus with hydrocephalus. The provision of these images grounds the user's knowledge in the perceptual aspect of the diagnostic skill being nurtured. As the questions are systematically addressed and answered, the Features table is filled out.

Suppose, however, that the user submits an incorrect diagnosis: acrania (i.e. the cranium of the fetus is missing). The system will begin to interact with the user to draw his attention to the particular features of the expert's schema that effectively disambiguate between acrania and hydrocephalus, the correct diagnosis. The system–user interaction is driven by an underlying table that has been defined for all features of interest across the different anatomical subsystems. In the present state of system implementation, the user is advised to work his way through the walk-through and to answer the question posed for each of the salient features that comprise the expert's schema. The next figure (Fig. 4) shows the user addressing the feature related to the presence or absence of the mid-line echo in acrania versus hydrocephalus in the ultrasound image.

To further enhance the salient dimension of the perceptual element that the system is attempting to direct the user's attention to, the user also has the option to turn on a highlighting feature that shows him the portion of the image to which he should be directing his attention.

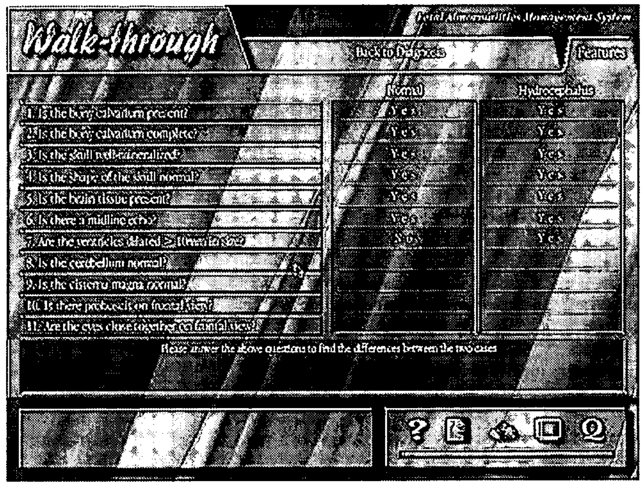

Figure 3: Walk-through for diagnosis of the Central Nervous System

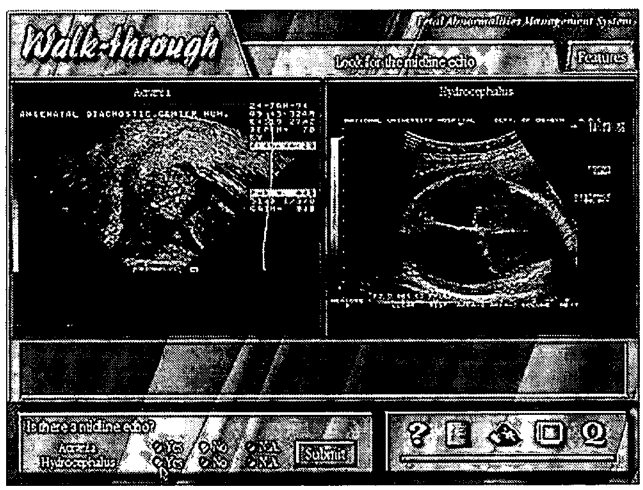

Figure 4: Contrast between the incorrect and correct diagnoses

It should be noted that when considering the above comparison, the user still retains the option of overlaying the image of a normal scan on the two images already displayed, as a further point of reference for making perceptual comparisons. As shown above, the user addresses the question "Is there a mid-line echo?" for both the incorrect diagnosis (acrania) and the correct diagnosis (hydrocephalus) and submits his answer to the system for verification. The radio button style of interface presents the user with a finite set of possible combinations that he can select. Hence, it is not ideal. When user modeling is incorporated, the system will reason interactively with the user on the disambiguating features that he appears not to have grasped or discerned. Notwithstanding, the above systematic walk-through is still a useful component of the system; it will be presented to the user when the system determines that the user's understanding is so weak that it would be more productive to place him in a training-oriented mode of learning.

Assuming that the user makes a correct diagnosis or is led to the correct diagnosis by the system, he then will have the option to proceed to the next section of the learning environment that addresses the management and consultancy of the patient mother or to return to the beginning of the system and select a new case to investigate.

Discussion

The system that has been described above is work in progress. The interface is constantly being revised and refined as we endeavor to provide the system with a stronger case-based orientation. We are also working on developing the system's user model. The main difficulty here is that our medical domain consultants do not, as yet, possess an explicit idea of how they themselves handle user modeling when coaching students in the performance of ultrasound scanning and the diagnosis of fetal abnormalities. In light of this, we intend to perform several empirical investigations of instructor–student interaction to flesh out the relevant attributes that should be tracked by the system and to get a better sense of students' learning processes.

We have reviewed our system with respect to the goal-based scenario design criteria set out at the beginning of this paper. We are satisfied that the system adequately achieves the criteria of thematic coherence, control and empowerment, challenge consistency, and pedagogical goal support. As for realism and richness, we are of the opinion that there is a large degree of realism as the simulated task that a user is confronted with is highly authentic. However, there is some degree of compromise with respect to richness that arises from the ultrasound domain. As a contrast, the domain of upper gastro-intestinal bleeding affords far richer possibilities in terms of the simulation that the system could be made to support. Such a domain supports incorporating the dimension of time criticality in making a diagnosis; this is an element that the ultrasound domain inherently does not support. We have certain reservations with respect to the responsiveness of the system, but we expect this to improve when the user modeling component of the system is in place. Finally, with respect to pedagogical goal resources, we are currently working on supplementing the current system with additional supporting tools and information so that students should not only be able to make the correct diagnosis of a fetal abnormality but also be able to fully understand the cause–effect relations underlying the abnormalities they discover. In this way, system users or trainee gynecologists will be better placed to assess the management and consultancy options open to them when they proceed to the second part of the goal-based learning environment.

Conclusion

In this paper, we have described a multimedia learning environment for learning how to diagnose fetal abnormalities. The system was designed based on principles derived from goal-based scenarios. It consists of two parts: the diagnosis part and the patient management and consultancy part, assuming that an abnormality has been diagnosed. To date, we have worked only on the first part of the project. Most of the media-based element of the project is in place. This work has not been easy to complete and the amount of time and effort needed to sift through and identify suitable video footage and image clips are enormous. We have gone to considerable trouble to ensure that we capture the best quality images that amply show the critical perceptual features of interest. We are proceeding to direct our attention to the user modeling aspect of the work so that the system will be capable of handling more direct and dynamic interaction with the user. The walk-through illustrated in the paper will only be executed when the user demonstrates very poor competence and is moved into a training-orinted mode of learning.

While the goal-based scenario that we are creating is related to the domain of ultrasonography, the system can be readily customized for use with any other image-based technologies in medicine; eg. MRI and CT-scans. As the system was developed using Macromedia Director, we also aim to have a PC–Macintosh cross-platform product when the research project is eventually completed.

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An architecture for intelligent support of authoring and tutoring in multimedia learning environments

Alexander Seitz
Dept. Of Artificial Intelligence, University of Ulm
D-89069 Ulm, Germany
email: seitz@ki.informatik.uni-ulm.de

Alke Martens, Jochen Bernauer
Dept. For Medical Documentation and Computer Science, University of Applied Science Ulm
D-89075 Ulm, Germany
email: alke.martens@zibmt.uni-ulm.de

Claudia Scheuerer
Central Institute for Biomedical Engineering, University of Ulm
D-89069 Ulm, Germany

Jens Thomsen
Department of Medical Microbiology and Hygiene, University Hospital of Ulm
D-89081 Ulm, Germany

Abstract: Both representing cases as fixed scripts as well as the development of initial expert systems as a basis for computer based tutoring systems is particularly difficult and time intensive in a multi-institutional development project. On the other hand, structured systematic knowledge and a common terminology is necessary for automatic generation of information and quiz pages as well as automatic feedback. Therefore we provide an architecture that relates tutoring cases to general concept representation systems containing common terminologies, and facilitates an incremental acquisition of systematic knowledge.

Introduction

When analyzing the problem solving methods of medics, experts combine the application of specialized domain knowledge with a case-based approach to find the right diagnosis and therapy (Patel et al. 1995). Therefore, the education of students of medicine should include both the imparting of systematic knowledge together with case-oriented learning. This applies also to computer based training systems.

Tutoring systems range from a hard coded representation of cases (Mayo Clinic 1996) to applications based on expert systems, where cases form an instantiation of pre-coded systematic knowledge (Schewe et al. 1996). In the former, the author has to develop fixed scripts of the tutoring process and gets no knowledge-based support for authoring and tutoring. The latter support the author by automatic generation of quiz and information pages and make an automatic feedback in the tutoring process possible.

If clinical institutions of different domains have to work on such an expert system component, an initial complete development is difficult and time expensive. On the other hand, an incremental "case by case" coding by different authors requires a common terminology and a framework identifying and relating the central, medical concepts. We developed an architecture that contains terminological groups from different concept representation systems. It allows the construction of systematic knowledge by linking items of these groups together when authors build tutoring cases. As a result of this process we obtain a medical knowledge base that comprises all knowledge acquired case by case. Elements of this knowledge base are integrated with the authoring and tutoring system into a learning environment. The basic parts of both systems are complemented by components that make use of the knowledge base to support authoring and tutoring processes (Fig. 1).

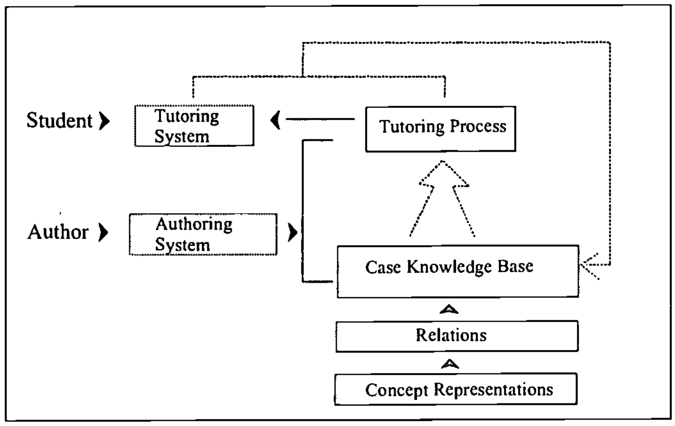

Figure 1: Architecture of the learning environment.

Identification of Central Concepts

The concepts a medic usually uses to describe a medical case can be divided into the following topics: anatomy, phenomena which are located at a specific anatomy (examples for the term 'phenomenon' are 'inflammation', 'pain'...), methods the medic uses to look for or to validate certain phenomena (examinations, technical examination, anamnesis) , diagnoses, and therapies. In our architecture, we reflect the medics' perspective by representing the according terminological groups in different hierarchies and sets:

- the hierarchy of anatomic structures and body systems,
- the set of phenomena,
- the hierarchy of what we call methods, which comprises different (technical and non-technical) examinations and the anamnesis,
- the hierarchy of diagnoses and
- the hierarchy of therapies.

Contrary to the elements in the concept hierarchies, phenomena are structured objects consisting of a phenomenon name and a set of properties. For example, some of the properties the phenomenon 'pain' could have, are 'intensity', 'duration' or 'quality'. In medical technical terminology, there exists a large range of systems for concept representation: classifications, nomenclatures or coding schemes. By separating the different hierarchies mentioned above, we are able to make use of existing terminology systems like special axes or parts of classifications, nomenclatures or special coding schemes. As an example, we utilize the "anatomy" axis of MeSH (Medical Subject Headings) (WHO 1992) and the ICD (Systematic Nomenclature of Medicine) (NLM 1999) diagnosis hierarchy.

Relating the Concepts

The information inherent in medical tutoring cases is mainly represented by links between concepts, which are given as hierarchy items and phenomenon instances. For example, we establish links that relate phenomena at a certain anatomic structure to examination methods they are based upon, and to diagnoses and therapies they imply (Fig. 2). Concrete cases constitute instances of this network.

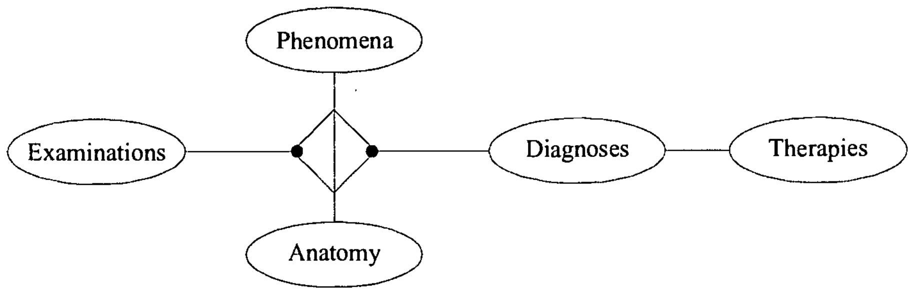

Figure 2: Integration of phenomena into concept graphs.

As an example, a tutoring case may describe a patient with anginose complaints. Because of this, the medic may order an electrocardiogram examination, which reveals a ST-segment depression. Taking other observed facts into consideration, the student's diagnosis should be myocardial infarction. One necessary therapy for this disease is intensive care. When the author describes this case, several links are established. The phenomenon 'ST-segment depression' is connected with the anatomic structure 'heart'. Their combination is linked both to the associated examination 'electrocardiogram' and the diagnosis 'myocardial infarction'. Finally the diagnosis 'myocardial infarction' is linked to the therapy 'intensive care'.

By following explicit links we obtain further implicit ones. For example, a relation between 'electrocardiogram' and 'myocardial infarction' results from their connections to the given anatomy and phenomenon combination.

Supporting the Authoring Process

We can use the hierarchies of anatomy, examination methods, diagnoses and therapies to support the author in formulating elements of tutoring cases. In (Fig. 3) an example of a tree-control is shown that offers a part of the MeSH anatomy structure for defining the location of a phenomenon. This can be done by selecting the appropriate concepts from the tree, which are inserted into the structured representation of the phenomenon on the right hand side of the depicted window.

When building a case for tutoring, the author describes a number of phenomena observed at the patient. Furthermore he is able to relate phenomena at a certain location to one or more differential diagnoses. Offering to him links from already constructed tutoring cases that provide differential diagnoses for the observed phenomena can support this process. Structured medical case knowledge is also useful for building quiz pages by integrating the set or a subset of those differential diagnoses plus some other irrelevant ones into the pages. The aim of these quiz pages is that the student specifies correct differential diagnoses at different stages of the patient information gathering process. The final diagnosis is put together with other differential diagnoses, for which not sufficient evidence exists, to build a quiz page to find the final diagnosis, as it is shown in (Fig. 4).

Furthermore, questions about any direct or indirect links within our architecture can be used to build quiz pages that are aimed at teaching the student the underlying concepts and their interrelations. For example, general questions like "what examinations can be performed on the specified anatomies" can be derived from the linkage of phenomena with examinations and anatomic structures.

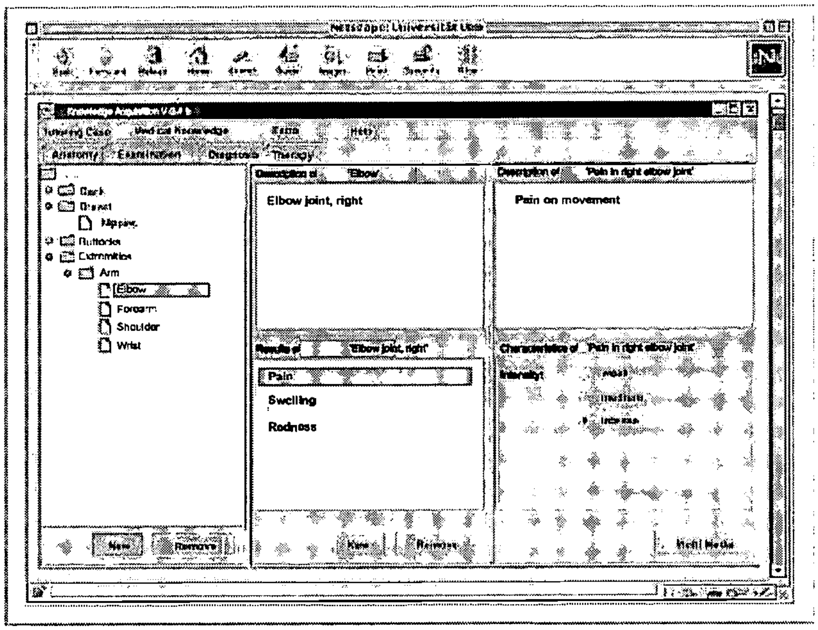

Figure 3: MeSH anatomy structure as a tree-control element.

The author can employ links for building information pages that teach the student the according associations of medical knowledge. Former experiences with tutoring software (Scheuerer et al. 1998) showed that relations we have made explicit in our architecture are an important subject matter in medical teaching. Information pages using text, pictures, animations or sounds illustrate both medical concepts and links between those concepts. Using concepts or concept combinations as indexes into databases of multimedia objects supports the author in creating those pages.

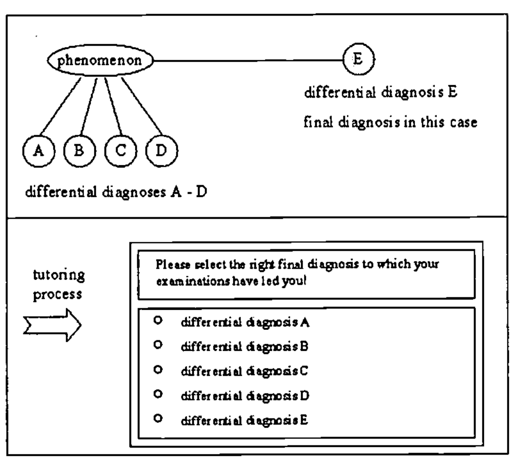

Figure 4: Sample quiz page derived from differential diagnoses and the final diagnosis for a phenomenon.

Supporting the Tutoring Process

The links mentioned above not only support the authoring processes but also the automatic generation of navigation aids, online information windows, and feedback in the tutoring process.

Menus based on hierarchies of examination procedures can be used to provide students in the tutoring process with possible choices for information gathering actions. The author is able to decide if the entire hierarchy or sub-hierarchies are shown to the student. It is also possible to focus examination methods on anatomic structures by using acquired links between them. In that case, a menu primarily showing an anatomic structure can be constructed. Every sub-menu has an additional menu item that pops up the according examination methods. This enables the student to select only those examinations that can be applied at specified anatomies. For example, links from the anatomy 'thyroid' to examinations like 'thyroid function test', 'radioisotope scanning', and 'sonography' could have been established in the case authoring process. Accordingly, this meaningful collection can be shown to the student as a selection of examination methods at the 'thyroid'.

Knowledge formalized within our architecture can be used for an automatic feedback generation in the tutoring process. We allow the quantitative or qualitative assessment of links between phenomenon-anatomy combinations and diagnoses, as it is done for example in the D3 expert system shell (Reinhardt 1997) by a number of positive and negative scores. By using this knowledge, comments and corrections that refer to a diagnosis chosen by the student can be automatically produced. To do this, the system searches for phenomena given in a tutoring case that plead for or rule out the diagnoses the student has chosen, according to the positive and negative links mentioned above. The student may be helped by this function at every stage of the tutoring process, because the described feedback methods take into account, what the student already knows about the patient. This approach can also be applied at links between diagnoses and therapies. Additionally, if not sufficient information about the patient was gathered by examination methods to confirm or exclude a diagnosis, the links mentioned above can be used to give hints to the necessary methods, or just to state that relevant information is still missing.

Conclusion

The presented architecture allows an integration of different concept representation systems for the building of tutoring cases. Additionally, we establish links between these concepts to formalize systematic knowledge within medical cases. This supports the use of a common terminology for cooperating authors and helps to avoid redundant case information. Furthermore, authoring and tutoring processes are supported by mechanisms for generating quiz and information pages and by automatic feedback based on the acquired systematic knowledge.

The presented work constitutes a first step in the project "Docs'n' Drugs – Die virtuelle Poliklinik". In this project, a tutoring system will be developed that shall represent a virtual clinic. Multiple clinical institutions, the University of Ulm, the University of Applied Science Ulm, and industrial partners are involved in this enterprise.

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Scaling Web-Based Instruction

T. Craig Montgomerie, Ph.D. <craig.montgomerie@ualberta.ca>
Mike Carbonaro, Ph.D. <mike.carbonaro@ualberta.ca>
JoAnne Davies, M.Ed. <joanne.davies@ualberta.ca>
Patricia Medici, B.S. <pr1@ualberta.ca>
Department of Educational Psychology
University of Alberta
Edmonton, Alberta, Canada

Abstract: This paper describes the design, development, delivery and evaluation of a Web-Based Instruction (WBI) course which has been designed to support a large number of students (approximately 700 per term). The paper describes the course philosophy, purpose and design, but concentrates on the issues that must be addressed when designing WBI courses for large groups of students.

Background

The Faculty of Education at the University of Alberta requires that all students complete a course in "computer applications." Historically, students could meet this requirement by taking either: a) a traditional face-to-face (F2F) lecture/laboratory course offered by the Department of Computing Science which could best be described as an "Introduction to Programming" course, or b) a traditional (F2F) lecture/laboratory course offered by the Faculty of Education which consisted of a 3-hour "demonstration" lecture followed by a 3-hour "workbook" laboratory each week.

In the 1997-98 academic year the computing course requirement for education students was decreased from 3 credits to 1.5 credits, causing an examination and reduction of the content of the course. After strong arguments, this decision was reversed for the 1998-1999 academic year. We decided that rather than simply re-instituting the course used prior to September 1997, we should completely redesign a 3-credit course for delivery in September 1999.

Faculty of the Instructional Technology program at the University of Alberta have been developing WBI courses for a number of years (e.g., Montgomerie & Harapnuik, 1997; Davies, 1998; Davies and Carbonaro, 1998). Because of our commitment to the precepts of active learning, and after examining the costs of delivering WBI (Harapnuik, Montgomerie & Torgerson, 1998), we decided to design the course to be delivered through Web-Based Instruction (WBI). The resulting course, *EDPY202: Instructional Applications of Technology* (http://www.quasar.ualberta.ca/edpy202) is publicly available on the Web.

Philosophy of the Course

Tell me and I will forget.
Show me and I will remember.
Involve me and I will understand.
(Variously Attributed)

The philosophy of this course centers on the theoretical perspective that learning is a process of constructing knowledge as opposed to a process of recording knowledge (Harel & Papert, 1991). From this perspective students are required to be "active participants" in their own learning. To support this perspective, students need to be placed in an environment whereby they have the opportunity to take ownership of their own learning. We have attempted to create such an environment in two ways. First we have designed the course to be self-paced with varying degrees of individualization. This approach allows students a higher level of flexibility with respect to course time commitments and the level of skills and knowledge they wish to acheive. Course materials can be studied individually, in collaboration with peers, or in collaboration with a more knowledgeable assistant. Second, we have focused learning activities on software tools used for problem-solving —"Mindtools" (Jonassen, 1996). This emphasizes students learning "with" the computer as opposed to "from" the computer. In other words, computer-based tools and learning environments (e.g. databases, spreadsheets, semantic networks, computer conferencing, hypermedia construction, or microworld environments) can serve as cognitive tools or extensions of the mind. With the use of such "Mindtools," learners can enter an intellectual partnership with the computer in order to access and interpret information, and organize personal knowledge. A recent article (Connell, 1997) concludes that "IA" (Intelligence Amplification) is preferred over "AI" (Artificial Intelligence). As Connell (1997) states: "In AI, ... models of an individual's cognitive processes ... serve as templates to construct intelligent systems capable of teacher replacement ... In IA, the roles of the machine and user are reversed. Instead of having a system in which the user responds to the machine, you have a system where the user uses a set of provided software construction tools to actively construct more powerful, personally meaningful representations of problem spaces" (p. 27).

Traditional educational paradigms must be shifted somewhat in order to successfully incorporate technology in this way. For technological tools to become student-centered "Mindtools" requires a readiness for change. For example, school schedules, the physical setup of classes, and assessment of both students and teachers may require modification to accommodate these new tools (Barron & Orwig, 1995).

We have made many such adjustments in this course. First, we have attempted to provide students with a lot of scheduling flexibility. We impose no requirement for lecture or lab attendance. The on-campus computer lab facility is available to students during a total of ten to twelve three-hour periods during the week (including some evening times) as well as two additional four-hour periods on the weekend. Subject to space limitations, students are free to use the lab and obtain in-person help from a teaching assistant during any of these time periods. Students also have virtually continuous access to instructor assistance (or peer collaboration) via Computer-Mediated Communication (CMC), in the form of email or web-based conferencing. Most students who prefer to work largely at a distance make extensive use of CMC. We do however, impose traditional assignment and course completion deadlines. This university is currently not prepared to allow undergraduates varying periods of elapsed times in which to finish courses.

Second, we have also changed our assessment methods as compared to many traditional courses. In this course, 60% of a student's grade is based on a portfolio of term work. This portfolio is a series of five modules which students must submit electronically. Each module consists of a computer file (or group of files) which demonstrate the students understanding of the various course topics. The content of their submissions is largely a matter of student choice and creativity, although in most cases, students must indicate how their project relates to the provincial education curriculum. The remaining 40% of a student's grade is based on a practical exam which they must write in-person in the on-campus computer lab facility. This lab exam is really a mini-portfolio of small projects using the same tools the students have learned during the course. The purpose of this exam is to obtain an objective assessment of the computer literacy level of each individual student, in comparison with peers. Students in this course receive final grades on the same traditional 9-point scale as most courses at this university.

Purpose of the Course

The purpose of teaching education students to use computers is so that they will be prepared to integrate the use of technology into the curriculum. This introductory course aims to provide undergraduate education students with the basic skills they will need to apply information technology in Kindergarten - Grade 12 schools. Although this course is primarily a software tools literacy course, it does provide the students with some exposure to curriculum integration. Thus, we hope that these soon-to-be teachers will be in a position to assist their students in using the information technology tools which are commonplace in modern society.

At the same time we were designing this course, the Government of Alberta published *Information and Communication Technology, Kindergarten to Grade 12: An Interim Program of Studies* (Alberta Education, 1998) which will form the basis for the provincial program of studies to be released in June 2000. This document is constructed in terms of "learner outcomes" and the philosophy is stated as:

> This technology curriculum is intended to provide a broad perspective on the nature of technology and its impact on society. Students will be encouraged to grapple with the complexities, as well as the advantages and disadvantages, of technologies in our lives and workplaces. It is not intended to be taught as a stand-alone course but rather to be infused within existing courses. Technology is best learned within the context of applications. Activities, projects, and problems that replicate real-life situations are effective resources for learning technology. (Alberta Education, 1998).

The objectives for EDPY202 are directly related to the Alberta Education document and students are required to complete either an introductory or an advanced module in each of five topic areas:

1. Internet Tools (Email, Web-based conferencing, Internet searching, FTP, Telnet, Simple WWW page creation),
2. Digital Media Processing (clip art, drawing, painting, scanning, digital photography, digital audio/video),
3. Multimedia/hypermedia Presentations: (PowerPoint or HyperStudio),
4. Spreadsheets (e.g. Excel), and
5. Databases (e.g. FileMaker Pro, Access).

Course Design

This course has been designed to be self-paced and modularized with a focus on independent study. Three optional lectures are given:

1. an introductory lecture covering the philosophy and operation of the course,
2. an introductory hands-on workshop concerning basic computer operation and terminology, and
3. a lecture the week before the final exam (lab practical) which explains what will be covered and the exam procedures.

All of this material is also available on the course Web page.

An introductory and an advanced module for each of the five topic areas have been prepared. Students must complete one module from each of the five areas. All modules follow the same structure with each module having sections on:

1. Just the Facts (a short overview of what needs to be done)
2. Purpose
3. Prerequisites

4. Objectives
5. Alberta Learner Outcomes (explanation and direct links to the sections in the "learner outcomes" document which are particularly addressed in this module),
6. Assignments, and
7. Resources.

A 3-hour/week laboratory period is assigned for each student, but students are encouraged to work at home rather than in the laboratory if they have the ability, equipment and software. This has two major results: firstly, many students appreciate the opportunity to take the course wherever and whenever they wish, and secondly, the teaching assistants in the lab can concentrate on helping those students who really need help. For example, students who are very novice computer users find it very difficult to work actively and independently, especially in the early stages of the course.

Issues for Courses with Large Enrollments

Most WBI courses are designed for delivery to a relatively small class of students. Our own courses (Montgomerie & Harapnuik, 1997; Davies, 1998; Davies and Carbonaro, 1998) have been delivered to classes as large as 80. The expected enrollment for EDPY202 is approximately 700 students per term. Given this, a number of issues dealing with efficiency of both instruction and administration needed to be considered.

Instructional Issues

The course home page was designed to give access to a list of navigation headings in the three categories of Course Information, Modules, and Tutorials. Figure 1 shows the drop down menus for the navigation categories.

Tutorials were developed for many of the specific topics in the course, but it was felt that it would be a waste of time to develop new, extensive tutorials on the Macintosh and Windows operating systems and on commercial productivity tools such as Microsoft Word, Microsoft Excel, Microsoft Access and FileMaker Pro. Our website has a extensive set of links to existing web-based tutorials. Some of these were developed at our university, while others are links to various external Internet sources. We also reviewed a number of commercial tutorials and chose the *MacAcademy / Windows Academy* series of CD-ROM-based instructional programs (http://www.macacademy.com/). We feel that these programs come extremely close to the kind of instruction that would occur in a small group demonstration with the additional ability for the student to stop the instruction, move to a different place in the instruction, and to search for a specific topic. We purchased a number of sets of these CD-ROMs and placed them on 48-hour reserve in the library. We have Macintosh computers in our laboratory, and we negotiated a license with *MacAcademy / Windows Academy* which allows us to put images of the Macintosh instructional CD-ROMs on a Macintosh G3 Server and to allow up to forty concurrent accesses. This has turned out to be an extremely good solution. Students can access the instruction whenever they want and can proceed at their own pace. The programs they are learning about are available on the same workstation, so students can move between the instruction and the application giving them the ability to pause the instruction to try what they just learned on the real application. While we have not yet permitted it (due to licensing issues), these instructional programs can be accessed over the Internet, and, with a relatively high-speed modem, they work extremely well.

Administrative Issues

When one is working with a class of 20 students, a number of administrative tasks are handled without thought. It is necessary to automate these tasks wherever possible when one is planning for a class of 700 students.

Computing Infrastructure

The delivery of a WBI course to large numbers of students, requires you to be cognizant of various computing infrastructure issues. The Web Server must be capable of handling a high number of concurrent hits and the local and wide area networks must be prepared for a large volume of traffic. Our course website (run on a Sun Unix system) is fairly busy; at the time of this writing we are experiencing thousands of hits per week with no problems. The Windows NT server which handles our web-based conferencing system (WebBoard) is extremely busy with several courses sharing this server. We have had to increase the memory in this server substantially to be able to handle the demand.

Identification of Students

An automated procedure was written to merge data from a number of different central university administrative files into a single record which contains the data necessary for the course, including: Name, Student ID number, Computer Identification (assigned to each student when they enroll at the University of Alberta), Course Section Identifier, and Laboratory Section Identifier.

Student Server Storage Space

Students need to have a place where they can store projects they are working on. We assign each student space on a central server which they can access either over AppleShare or via the File Transfer Protocol (FTP). An automated process creates the Server Identification (Login ID) for each student which is the same as their University Computer Identification. An obvious scaling issue that arises in this area is how much disk space one can afford to allocate to students, particularly in a course such as ours in which students are expected to create rather large multimedia files. We provide students with a very modest 20 MB of space on our course server (in addition to the 5 MB they receive on the university's general server). However, when multiplied by several hundred students, it amounts to several gigabytes of hard drive storage that we must budget for and arrange with the university's network administration. We insist that students compress (e.g. Stuffit or Zip) assignment files to help conserve disk space. However, most students do eventually exhaust their 20 MB, so we suggest that they archive older assignments on other media such as a 100MB ZIP disk.

Web-Based Conference System

We feel that it is important that students can communicate with each other, with the laboratory assistants and with the instructors. We use WebBoard (O'Reilly Software, 1999), a computer conferencing system, to provide for this communication. An automated process creates the WebBoard Identification for each student that is the same as their University Computer Identification.

There are various scaling issues that arise when utilizing such a conferencing system for a large group of students. One must be prepared for a large volume of messages. We have found it very useful to break up the conferencing system into more manageable sub-conferences, particularly in the case (such as in one of our course modules) where student conferencing messages are an assignment requirement. Students should not be required to wade through hundreds of messages at a time. In our course, we have also set up conference sub-topics for help questions related to specific software tools.

Another problem is that some students do not naturally know how to provide enough details when asking a question on a web-based conferencing system. They ask a question as if they are talking to someone looking over their shoulder. Instructors have to reply asking for more information - multiply this by large numbers of students and you add to the volume of messages. This is particularly a problem at the beginning of the course, but as the students get used to this mode of communication they learn to describe their situation more accurately the first time.

Another consideration is that adequate, paid instructor / teaching assistant time must be allocated to monitoring and answering conference messages relatively quickly, including evenings and weekends. This last consideration is also an important factor in dealing with student email messages in a large course. Although general questions are raised on the WebBoard, student concerns of a more personal nature are handled via private email. In a large course such as ours, the volume of messages can obviously become very high.

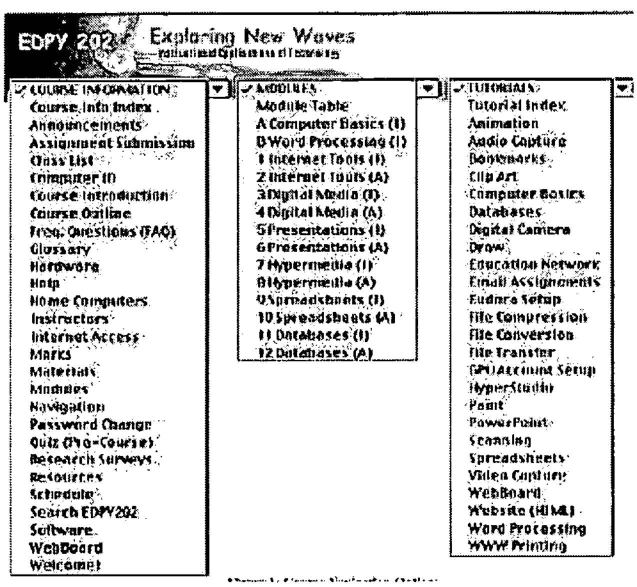

Figure 1: Course Navigation Options

Common Password

Students in our course access four individual computer systems (i.e. the WebBoard, the Marks Database, the Course File

Server, and the University's general purpose server), each of which has its own logon ID and Password. During our registration procedure we force all the IDs for a user to be the same as that already set for access to the general university server. We also set the password for the three systems under our control to have the same password. On the Web page (and in the first laboratory period), we demonstrate how to set the general university password to be the same as the other three. Finally, we provide a single Web page that allows student to change all of their passwords at once. Students very quickly forget that they are using a number of different computers with different ID/password configurations when all their IDs and Passwords are the same.

Our university is installing a common file system: *Andrew File System* (Transarc, 1998); and common authentication service: *Kerberos* (Neuman & Ts'o, 1994). Many other post-secondary education institutions and businesses are installing similar systems. At this time our Faculty has not integrated with AFS and Kerberos. In some ways this is unfortunate - it would have been nice not to have to "reinvent the wheel", but having to build our own systems did give us a little more control.

Submission of Assignments

Students need to be able to submit their assignments for marking. When server storage space is set up for the student, a "submit" directory is set up within that space. Students are told to place their assignments in that directory (either through AppleShare or FTP) when it is ready to be marked. We require that the assignments for each module be placed in a single compressed archive. At the time the assignment is due, an automated procedure scans the "submit" directories in the student files, makes a copy of any new archives which are in the students' "submit" directories, reassigns ownership of these copied archives and places them in a folder for the Markers to access. This procedure also sends an automated, time stamped e-mail message to each student telling them which (if any) files were copied and which were not copied. The message also states specifically why a file was not copied (e.g., an earlier copy of the file existed, the file was not in an archive (i.e., it was not in .sit or .zip format)).

Marking Assignments/Exams

A marks database was built using a Web enhanced ACCESS database. This is a modification of the system reported in Montgomerie, Harapnuik & Palmer (1997). Markers and staff view the database as if it is a spreadsheet and can enter and change marks and comments for each assignment via a web browser. We provide students with a web-based query which allows them to see only their own marks and comments. We have also developed several customized database queries that help to ensure the correctness and completeness of our marking, for example, by pointing out students who have not received a grade for a particular module. In smaller courses this is usually done manually with little effort, but in a large course, ensuring that all marks have been entered is a serious concern. The course administrator also has the ability to automatically compute the final course 9-point grade for all students by specifying raw-score cutoffs. This is a huge time saver, as manual entry of each student's final grade would take several hours. The database also has a report capability that produces the "official" mark sheets in the form that the Office of the Registrar requires. It is hoped that when the University's new student record system is completed, electronic transfer of marks to the Registrar system will be allowed.

Student Evaluation of the Course

The first administration of the course was during September – December, 1998. Two hundred and forty students enrolled in 12 lab sections were asked to rate their technology anxiety and personal thoughts about using computers. These students were observed working in the lab. Some of these students were also interviewed.

Students enrolled in the Faculty of Education are required to take either this course or a course offered by the Department of Computing Science; therefore, student motivation could affect the ratings. Students did not know the identity of the teaching assistants at the time of registration, hence they could not select their laboratory section based on teaching assistant reputation. Both Elementary and Secondary Education students were enrolled in the course. Students can attend any lab section which had space available. Each lab section has at least two teaching assistants with the ratio is one TA for each 15 students.

Overall students had a positive perception of technology, the use of computers and the course. Students liked the idea of working on their own pace. Students felt comfortable knowing that they could always find a TA in any lab section and were glad that extra Saturday and Sunday lab sections were offered. Students found the course interesting and 69% of the students interviewed believed that they would use this knowledge in classroom. Although students reported a high the level of anxiety in the beginning of the course, the same students reported that this anxiety dropped considerably after one month in the course.

Students working at home reported that they were very pleased with the course and the support they received from the course instructor and teaching assistants. They stressed that they can work fast since all the material they need is on the Internet and it is relevant to the curriculum. They also point out that this kind of course saves their time because they did not need to be at the university.

However there is always some room for improvement. Novice computer users scored high in the anxiety scale survey. Most of the novice students reported that the material was very challenging and there was not enough time to study the material on the Internet and do the assignments. They also reported that the teaching assistants did not spend enough time with them. This situation was also observed in some lab sections.

The course had some communications problems. Some of the students reported not being able to contact the instructor or the TA using the e-mail or the WebBoard. The WebBoard was also underutilized. A large number of students stated that they used the WebBoard only to do the required assignment and they never looked at it again until the end of the course. Other students reported that they did not get good answers to questions which were e-mailed to the TA. On the other hand, it was observed that some students can not state their questions or comments clearly when they are writing the e-mail messages. Some students reported that they were unable to get any assignment marks back until the end of the course and others reported that assignments were apparently not marked.

The course has a great number of teaching assistants and it was observed that different TAs gave different interpretations of requirements. It was observed that there were not enough TAs in some lab sections to provide good service to the students. In some situations it was observed that students had to wait more than fifteen minutes for help. Some students also wanted to see the course instructors in the lab sections.

These criticisms are being addressed in the current implementation of the course.

Conclusion

This paper has discussed the philosophy, purpose and design of *EDPY202: Instructional Applications of Technology* and provided some of the student feedback. The course is offered primarily through Web-Based Instruction. While there have been some "birthing pains," and we expect even more "growing pains," we are very pleased with the results so far.

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Quipunet: A "Virtual", Educational Organization;

Martha Davies, President
Quipunet
1888 Yukon Harbor Dr.
Port Orchard, WA 98366
mdavies@telebyte.net

Abstract: Quipunet, a "virtual", educational organization, with the use of Internet's simplest tools has been acquiring valuable experiences since the latter part of 1995. We have presented virtual seminars in cooperation with UN-IDNDR (United Nations- International Decade for Natural Disasters Reduction); have established communication networks with rural areas in Peru, allowing us to help the victims of disasters ; have used same networks to build "bridges" to embrace needy schools; and have sponsored virtual, Writing Contests among the schools of Peru, involving students, teachers, schools and city officials.

Introduction

From the beginning of time when man ventured into uncharted territories, with no one to guide him, with no rules to follow, he had to improvise, try out, make mistakes, and try again; in short, he had to *Learn by Doing*.

The Internet was to us that uncharted territory, a new frontier that offered untold wealth of information and knowledge; the place where Quipunet could be created. http://www.quipu.net

Quipunet is a grassroots, "virtual", non-profit organization, legally incorporated in the State of Washington since November of 1995. Quipunet is made up of Peruvian volunteers living all over the world, who have formed a cybernetic link to help our country of birth.

We come from all walks of life, architects, engineers, professors, students, diplomats, business people, and housewives. We reside in different parts of the world, some of us, computer literate, and some, unfamiliar with the Internet. We are, truly, a virtual village.

The name, Quipunet, was taken from the *Quechua* word *Quipus*. The *Quipus* were used by the Incas as a means of maintaining a statistical inventory of their Empire. Long, braided strands of colored yarn each strand had a number of varied knots. Using a coded system where each color, each knot, each strand represented something, the Incas were able to tally and record their resources. Our pages, filled with information, are, our electronic *Quipus*.

We like to think that we are creating a new future utilizing modern technology -and - ancient, Inca customs.

Who we are

What we have learned during our three and a half short years of our existence merits the telling. We have been pioneering the Internet with no one funding us.
We never dreamt that our small group, with scant means, could help so many, from so far. It is the Internet that has given us these new tools, to learn and use; it is the Internet that has been our "frontier" where everyday we find more rich lodes to mine. Where the potential to really make a difference is open to anyone no matter where he or she lives. All anyone needs is the most basic knowledge of one of the most useful tools of the Internet; the electronic mail.

Along with e-mail comes the use of mailing lists. These are something like network conversation clubs, or special interest groups. San Francisco State University had such a list for Peruvians, where we discussed affairs of our country, exchanged recipes, told stories, and had serious debates. It was during one of these debates that the idea to help at a distance was put forth, and it caught the imagination of us all! This idea turned into a project, the project into an organization. A dream was born! It was very emotional seeing the messages "count me in!", "count me in!". What started with only a handful, soon grew to seventy, then eighty, ninety volunteers. It was time to organize our ideas formally, thus, a committee of six persons was formed: Alberto Delgado in Japan, Herbert Luna in Brazil, Fernando Hermoza in Peru, Ricardo Corzo in Virginia, USA, Felipe Polo Wood in North Carolina, USA, and Martha Davies in Washington, USA. Six persons who hardly knew each other, with the task to organize this volunteer group!

The First Learning Experience:

The first few days we all had excuses; the national holidays, vacations, weekends, etc. Nobody wanted to be the "first". I think we were all asking ourselves: "now, what?" Up to this day, none of us can recall how we started, but once we did there was no stopping us. After 186 e-mail messages, and 6 complete corrections, we finished the "draft" of our By-laws, Action Plan, Time Schedule, and even the subscription form! All done in three and a half weeks! It was an experience we'll never forget! The experienced "old hands" in the Internet, as well as the neophytes, were in awe at seeing the documents taking shape line by line, day by day. We all had learned how to use a virtual table!

The Second Learning Experience:

The "draft" was presented to the rest of the members and Quipunet's second learning experience was put into motion. Another committee was formed - it was their turn to learn. They used pre-registration and voting "tables" to make it easier to handle and to avoid a sea of e-mail. Even with all this careful planning we received complains of too much mail. But the results were worth all the trouble. The election was a totally transparent event!

And so, Quipunet was born, in November of 1995, with the following mission:

"To Channel resources, materials, and knowledge available all over the world to the places most in need in South America, with emphasis on Peru".

The Third Learning Experience:

Our first official incursion on this new, exciting field called Internet, was planned by our Vice-president, Alberto Delgado, who at that time was living in Japan. He convinced several of his colleagues at work and from the University of Kobe to contribute information gathered after the terrible earthquake in Kobe.

In January of 1996. We presented: *"Kobe-Japan: the Earthquake of 1995 and its Lessons"* - We had 167 attendees from 16 countries. We were delighted to learn that some attendees were from rural areas. The presenters were top-notch people from Japan whose experiences were still fresh in their minds.

The Fourth Learning Experience:

Somebody from the UN-IDNDR. (United Nations- International Decade for Natural Disasters Reduction) took notice of this seminar and asked us to collaborate with them on their first virtual seminar: *"Solutions for Cities at Risk"*. It was scheduled for September-October 1996. http://www.quipu.net:1996
That event attracted 458 attendees from 58 countries. Our pages registered over 8,000 "hits". We learned about the Master plan of Istanbul for earthquake hazards; we learned of the vast potential of the Internet to link individuals and institutions around the world; we learned about building codes, and about urban protection strategies.

On September -to- October, 1997 in cooperation with UN-IDNDR we presented: *"Floods and Droughts: Issues of the 21st Century"*. http://www.quipu.net:1997
This seminar was a smashing hit! Presented in two languages, Spanish and English, both on our pages and on two lists. This one had close to 700 attendees from 60 countries and our pages registered over 9,000 hits. This seminar was also the first one I was involved from the beginning and let me tell you how impressed I was.

Picture this: From Geneva, the word goes to Alberto Delgado, our vice-president who by then lived in Ecuador. Let's have the seminar. Alberto gets his "team" ready. Three Webmasters: one in Australia, one in Peru and one in USA. The workplace: San Francisco State University, where our server resides, and where we had two more team members. Manager for the Spanish list was in Taiwan; and manager for the English list, Alberto, in Ecuador. Two volunteers in Peru took care of the publicity in Spanish. That year we had eleven translators, five in Peru, four in the States, one in Spain and one in Taiwan.
We took care of only the technical part. UN-IDNDR took care of the presenters, who that time were from Australia, Burkina Faso, Argentina, Spain, USA, Cambodia and many other countries. Quite an undertaking...and what a good example of sharing problems and solutions... globally! We learned about the community response to the Red River flooding in Manitoba, Canada; the risks of flooding in Australia; the risks and prevention in Valencia, Spain... we learned this and more. It was an excellent seminar with valuable, first hand information.

Last year's seminar: *"Prevention Begins with Information.* http://www.quipu.net:1998 involved the media as a very important partner to build a culture of prevention. Information prior to disasters is crucial to the saving of lives and property. The media has to help educate the public but it is up to the scientists to relay clear and understandable messages. We had several representatives of the International media and also representatives of different organizations around the world.

These seminars have helped developed nations as well as developing nations. We have shared wisdom and valued experiences on equal footing. Rich technology and ingenuity based on necessity, make good partners.
As for our personal learning. Early on we realized that we had to keep the seminars relatively simple in order to reach the rural areas where the cost of connectivity is so high. By presenting the seminars in the WWW -page format, without the frills that takes so long to load; and also by using lists, we were able to reach people that have only e-mail.

The Fifth Learning Experience:

The next lessons were painful to learn, because it was through tragedy that we were made aware of the Importance of telecommunication -and- the power of networking during disasters.

The visit from "El Niño"

On February, 1998 El Niño, the current that had always been welcomed as the giver of bounty to my country, that year was the destroyer of life, property, and hope, bringing along heavy rains in places where never rained, washing away whole towns that were ill prepared to resist the flooding.

When Edwin San Roman, one of our volunteers who lives in Lima, Peru, heard of the devastation caused by flooding in Ica, a city 3 hrs away from Lima, he took off with an industrial bread making machine in the back of his pick-up. With the help of the Catholic Church, he installed the machine in an empty school.
He sent a message to our list asking for help. I forwarded his message and urged our members: "Let's help Edwin, to help Ica". As the pledges arrived I would post the amount and the running total to our mailing list. Edwin, in Lima, reading the totals, would in turn, use his credit to buy flour and yeast. His messages kept us abreast of what was happening. He made each of us participants. Perhaps not in body, but in spirit. We were there--- helping make 30,000 rolls of bread a day to feed the homeless, hungry people. We held the fort--- until the big organizations took over. According to the bishop of Ica, it was the best organized team effort! And all this was possible- thanks to e-mail and the mailing lists!

The next story is one with a lesson we are taking to heart.

Another volunteer, Raul Nakasone, resident of the USA, spends his vacations in Guadalupe, a small town in Peru. Last vacation he persuaded Hugo Cortez, President of the Board of Directors of the "Public Aid Office" of Guadalupe, to invest in a computer for the town. It would be a "window to the world" he told them. And so it was. When the computer was installed only three people knew how to use it. Before Raul left he taught a few more.
Back in Olympia, WA, Raul kept in contact with his town via e-mail. And he gave them instructions on how to be prepared for the rains that were supposed to arrive. Of course nobody was prepared for the magnitude of the disaster that was to hit them. The heavy rains caused mudslides that destroyed the roads. The town was isolated....but not abandoned. Raul wrote, "Be sure to boil all the water to prevent cholera". The people followed his advice and bought two wood-stoves and kept them going day and night. But two stoves weren't enough for the whole town. So Raul asked Quipunet for help and since we had been collecting funds, we had $1,000 to send to Guadalupe. Raul's instruction-at-a-distance went like this: "Sra. Juanita- (she is the president of the association of mothers in Guadalupe), be sure to buy a notebook and keep track of all the money, who is getting what. Have everybody sign. You and your committee can decide what your most important needs are." One computer in that town and only a handful of people that knew how to use it! But it was enough to help them!

The Sixth Learning Experience:

One of our most successful projects this one was born at one of the lists of interest called SEDERUL (Servicio de Desarrollo Rural). We had wanted to promote an interchange of ideas and experiences in three important fields. Education, Agriculture and Rural Tourism. Combining these three, the Work Group in charge of this project decided to have a writing contest for high school students from public schools in Peru. The theme they choose was "The Natural Resources of my Land."
Invitations were sent to 130 schools, and to involve the whole community prizes were offered for the student, the teacher, the school and the community.
First prize was a computer for the school, and $100 US for the student and another $100 for the teacher, prizes went all the way down to $10.
This project, like all the other projects we have worked at, was planned and executed at-a distance. With small groups at each end taking care of the details like diplomas, prizes, etc.
It was an outstanding success and one we are going to repeat again this year!

Other projects we are working on:

Embrace a School:

We have created nine work groups in the USA, which through benefits such as dinners, dances, and musicals are helping needy rural schools. Our aim is to provide these schools with one computer each. We believe that computers and several donated educative programs, makes a better, long-term, cost-efficient investment that will last for a number of years. We want to provide instruction and education -at-a-distance not only to the kids but also to the teachers, opening a window to the world. Educational materials are almost non-existent in many of the rural schools.
The reports from an inspection trip on November 1998 were very encouraging. All the projects were working as planned; the results better than expected. The following are the best examples:
1- Embracing the Little Farmers, in Cusco, Peru. We are working with an organization formed by young business owners, giving of their time and whose aim is to teach native kids the best ways to farm their small lots of land. Whatever the kids can produce, and if of good quality, it is bought at market prices by the business owners. This is the best, well-planned, full-cycle, program we have seen.
2- A Training Center for Street Kids. These are kids that only two years ago were stealing in the streets. With our help, they are being trained to make shoes. The self-esteem, and pride while showing their product, was beautiful to see.
3- The Women Carpenters. A whole town had to be resettled after the flooding caused by El Niño that left them homeless. Our volunteers who visited their camp, after seeing the women making benches from apple crates,

decided to pay for the training and material to enable them to help themselves. After 3 months of training, the women delivered benches, tables, and bookshelves for the school. They also *learned by doing!*

My Friend: The Book:

We collect used text books and when we have enough boxes, we send them to different universities.

What have we learned?

That this era of information and knowledge will drastically change our world as we know it.

That we, the people from developing countries, have to use more imagination and creativity, in lieu of money we don't have. But it can be done.

That we must use simple tools to reach the people that only has simple technology.

That the communication networking is the most important component for the dissemination of information.

That the Internet is open to all the world to be mined with sophisticated technology, or with rudimentary tools.

That we all have valuable information to exchange. Traditional knowledge, in exchange for up-to-date information.

That there is room for us all in this new frontier. We all are needed to fill out the different jobs being created.

And most important of all, that we have a unique chance to really stop the devastation of the world by channeling education and information so people can better understand and take care of their quality of life, preserve their environment, and their own culture.

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Exploring The Nature Of Self-Regulated Learning With Multimedia

Dr Sue Stoney,
Faculty of Business
Edith Cowan University
Pearson Street
Churchlands 6018
Western Australia
phone: 619 272 8502
email: s.stoney@cowan.edu.au

Dr Ron Oliver
Edith Cowan University,
Bradford St,
Mt Lawley, 6050,
Western Australia.
phone 619 370 6372
email r.oliver @cowan.edu.au

Abstract: The study outlined in this paper was part of a larger study that examined the use of interactive multimedia in motivating and engaging adult learners. This paper describes the use of the multimedia microworld to explore and promote the use of self-regulated learning, and in particular examines the degree to which higher order thinking was achieved and concludes by suggesting ways in which these learner effects could be achieved to a higher degree.

Introduction

As computers become more and more integrated into higher education activities, it is imperative that learning programs be designed to exploit the flexibility that resource-based, self-paced learning can provide. In order to use the computer as a primary learning tool, the very nature of learning with technology has to be rethought. Interactive Multimedia has, to date, failed to fulfil its early promise of making a significant difference to the way in which learners learn (Russell, 1997). One of the reasons for this may be that multimedia programs are designed for a single focal point teaching through a linear sequential process, with students confined to a narrow learning experience. However, with a well constructed multimedia program, the experience of the student changes to one of cooperative, contextual learning where students are left to explore the learning environment in their own time, at their own pace and in any order of their choosing. This form of learning has the potential to increase the motivation and engagement of the students (Stoney & Oliver, 1997).

This paper will explore the notion that students who learn in an applied setting, such as a microworld, will experience cognitive engagement and motivation through the relevance of the material to the students' real world or macroworld.

Cognitive Engagement

Cognitive engagement is observable when the learners are giving sustained, engaged attention to a task requiring mental effort; and authentic, useful learning is produced by extended engagement in optimally complex cognitive activities (Corno & Mandinach, 1983). Cognitive engagement and motivation are inextricably linked together through mental representations, monitoring, and evaluation of responses and strategic thinking. The amount of cognitive effort expended is an appropriate index of motivation as it relies on the learner focusing on mastering the learning task and maintaining a high sense of personal efficacy (Shunk, 1989).

The highest form of cognitive engagement is self-regulated learning (Corno & Mandinach, 1983), where learners plan and manage their own learning and have a high degree of personal control and autonomy. This is critical to beginning and ongoing motivation through specific cognitive activities, and assumes that the students' prior learning will act in concert with the instruction to determine the types of cognitive engagement they exhibit, such as attention to specific information, analysis and synthesis of information, visualisation and ability to filter out relevant from irrelevant information. Effective cognitive engagement involves selectivity, task-specific planning, drawing on previous experience and transferring new knowledge to the world outside the classroom. The use of interactive multimedia can foster and develop cognitive engagement through its ability to attract and hold students' attention and focus. The very attributes that provide the potential to develop cognitive engagement, however, are also those that hold strong prospects for limiting and impeding learning. Research into programs and applications which encourage self-regulation and learner control frequently reports problems associated with learners' inabilities to successfully monitor and manage their learning, and to remain engaged and focussed on the learning tasks. Solutions that seek to enforce control or direction over learners, help to encourage the focus but are able to stifle the freedom associated with the forms of cognitive processing and engagement associated with higher order learning.

This paper describes a study in which a multimedia program—developed for use in a university course in the business field—was implemented in controlled settings that enabled an exploration of the higher order learning processes of learners. The program, *Principles of Financial Investment*, was designed and developed to support and encourage independent and self-regulated learning. Deliberate aspects of the design included elements to motivate and engage adult learners and past papers have explored and described:

- the instructional design principles guiding program development (Stoney & Oliver, 1998);
- learner response to the various design elements, (Stoney & Oliver, 1998); and
- the forms of motivation and engagement among adult learners supported by the learning environment (Stoney & Oliver, 1998).

Principles of Finance

The IMM program that was planned to replace a conventional course in business finance, was carefully designed to incorporate not only the learning sequences needed to bring about the cognitive outcomes but also to include a strong affective component. The microworld consists of an office building called "Investment House". Upon entering the building students are asked to register at the reception desk allowing the program to be personalised.

There are four main working/operating areas; the stock exchange, a stock broker, the Institute of Sound Investment and the student's office. The nature of the interactions was also considered to maximise engagement and motivation, so a passive click and read type program was avoided. The interaction style supported the narrative intention, enhancing the participant's relationship with the product (Stoney & Oliver, 1997).

The Study

The multimedia program was incorporated into the course of study for students studying Finance. Eight of the students were divided into dyads for the purpose of this study and used the program in a collaborative fashion. The students worked in a self-regulated fashion to complete the learning activities supported by the program in controlled settings that enabled the researchers to observe their activities and to record their communication and interactions. These students participated in an in-depth study and their discourse was transcribed and analysed to determine the forms and scope of cognitive engagement and to enable exploration of the higher order learning that occurred.

Findings

The resultant conversations revealed several levels of cognitive engagement and activity among the dyads. To further explore and analyse the instances of cognitive engagement, an array of learning activities were categorised and identified in the dyad activities. In the following discussion, we have separated the analysis and discussion of the forms of talk and cognitive activity into sections that describe lower and higher order thinking and learning.

Lower Order Activity

Lower order activity can be identified as any operational tasks requiring more than mechanistic activities, needing almost no cognitive engagement, problem solving or decision making (Stoney & Oliver, 1998). The students' lower order activities were divided into three main sections—lower order talk, information seeking, procedural, and browsing. Table 1 provides an overview of the categories by which the lower order talk and thinking was identified (after Herrington, 1997):

Table 1. Summary chart of classification of talk by pairs

Category	Sub-Category	Definition	Summary of student talk	Example of type
Procedural	Equipment	Any discussion regarding the hardware.	These comments related to the computer crashing.	M: Oh, the computer's stuck. We'll have to start again.
	Software	Any discussion regarding the operation of the program or problems with the software.	There were very few comments of this nature, but one pair could see the desktop behind the program which caused one of them some difficulties.	K: Do you find it a bit disconcerting with all this behind it? B: It is a bit, yeah K: You're trying to read it and there's all the little bits.
	Task	Any discussion regarding the requirements of the tasks.	This type of talk related to the ways in which the students decided to move through the program and the order of their tasks.	J: What do you reckon? Do you think we have to go back to the Institute?
Browsing		Any exchange where the students were talking about looking to see what was available.	There were very few incidences of this type of talk. The collaborating students did very little browsing.	S: Let's have a quick look round first. M: Good idea, see what's here.
Lower Order		Any exchange which was of a routine nature, such as agreeing, commenting without applying thought or judgement.	Talk in this category included many routine comments about the task.	G: Tell you what this program really brings some concepts back.
Information Seeking		Any exchange where the students were actively seeking information, but were not making judgements about it.	Comments in this category were made when students decided to look for information provided to help them make the investment decisions. There were comparatively few comments in this area as most of the pairs worked out their own information.	M: Let's check what the economic forecasts have to say about all this.

Off task activities are those that occur when the students lose engagement with the program. The off task activities noted in the study in question, were caused by students being tired or listening to what other students were doing. The technology also caused some distraction from the program when it crashed or failed to operate as expected. Table 2 shows the percentage of time each pair spent in the lower order activities as defined above.

Table 2. Percentage of time spent in lower activities by each pair

Pair No	Procedural, equipment, s/ware, task	Browsing	Lower order talk	Information seeking	Total time in Lower order activities
1	10	1	18	3	32
2	22	1	16	9	48
3	15	3	25	7	50
4	10	4	25	13	52

It was noted from the in-depth study that generally the students spent very little time browsing, instead preferring to talk their way through the program and the problems. There was quite a high percentage of procedural talk, probably due to the fact that the program was a test version and had some minor glitches. The percentage of time spent in information seeking was generally low, with the exception of pair 4, who spent more than 10% of their time in this activity. The incidence of lower order talk was much higher than expected, and this could be attributed to the fact that the program was fairly complex and therefore students spent time reading aloud to each other, discussing routine factors such as where to go next and making comments that did not apply thought or judgement. Although there were many instances where the lower order talk was intermingled with the higher order talk, generally most of the students spent the initial part of their time discussing procedures and actively seeking information before moving on to higher order thinking.

The initial high percentage of lower order talk by students using the program was expected, as the students explored and experimented with the structure of the program, and this dropped away towards the middle and end of the time as students became more familiar with the structure and content of the program. Although the amount of time spent in lower order activities varied between the dyad groups, they spent fairly similar amounts of time browsing. The main differences between the groups were information seeking (ranging from 3% to 13%), procedural issues (ranging from 10% to 22%), and lower order talk (ranging from 16% to 25%). The types of issues which contributed to the lower order activities were problems with the system; for example when one of the students was distracted by the desktop showing behind the program, or when the system crashed. Some of the students also found that they needed to be directed to the paper-based instructions, although they still tended to want to talk through their navigational problems than read a manual. Much of the lower order activity involved student talk which was of a routine nature, where students were agreeing, reading aloud, and commenting without judging. A much smaller percentage of the lower order activities involved information seeking where students were actively looking for information and discussing it without judging it. Although much of the lower order talk was necessary in terms of the students working out how the program worked and commenting on incidents occurring in the program, some of the occurrences could have been eliminated by ensuring that the program was more stable, and by including more problems for the students to solve.

Higher order thinking

An important facet of developing higher order thinking skills is the ability to reflect on the learning experience and incorporate new knowledge with the pre-existing knowledge. Although the importance of reflection is well documented (eg Laurillard, 1995; Merriam, 1993), it is rarely supported as it is internalised by the student often without the instructor being aware of the process (Laurillard, 1995). Teacher oriented classes provide the least amount of time for reflection, but self-paced, resource-based instruction, such as multimedia, is capable of promoting the links between conceptual and experiential learning. This can be achieved by building in a variety of scenarios that offer alternatives to students, giving them choices from which to change their understanding of a concept whilst being able to relate it to their own world.

Traditional teaching often employs a lock-step approach to the acquisition of skills, with lower order skills being taught first. There is a belief that lower order skills are prerequisites to higher order skills and that mastery of lower order skills automatically leads to higher order skills. In fact, lower order and higher order skills can be taught concomitantly, with students mastering both levels as they apply their learning, rather than learning the skills, practicing and then applying them. This prevents skills being learned in isolation and students then having to relearn their application to real world tasks. The students are active in the learning process, applying problem-solving in context which in turn aids in the acquisition of skills, giving the students a reason to learn and helping them how to learn. In the study described in this paper, higher order thinking was classified into five main categories: planning/strategy; uncertainty; predicting/imposing meaning; multiple perspectives; and coaching (Herrington, 1997). Table 3. gives a breakdown of the classification of the categories.

Table 3. Summary chart of classification of higher order talk by pairs

Category	Definition	Example of student talk
Planning/ Strategy	Decision making (Lewis & Smith, 1993), considering strategies and planning events.	"Yeah, well I reckon that Castle Mining is overvalued so why don't we check out what the broker has to say about that, and then maybe look at the quarterly reports to see if there's some sort of a trend?" (Steve talk).
Uncertainty	Any statement expressing uncertainty. Any question clarifying a point (Ennis, 1993).	"One point one, where's the 12 come from, percent, where's the 16% come from? Don't know?" (Mark talk)
Predicting/ Imposing	Making a prediction, deciding what to believe, solving non-routine problems (Lewis & Smith, 1993), making	"Net present value is the current value or adjusted value on the discounted cash flow rates, huh" (Gary talk)

meaning	judgements (Ennis, 1993). Exploration of the problem, using inference, induction and deduction (Garrison, 1992).	
Multiple perspectives	Establishing different perspectives (Duchastel, 1990). Grounding in the real world (Garrison, 1992).	"I know, isn't that interesting, Northern Queensland, Western Australia, Cuba. I didn't know Cuba produced gold. I don't know what to do with the market at the moment 'cos you wouldn't buy gold at the moment" (Kelly talk).
Coaching	Accessing hints help in the form of support, advice, and explanations. Students teaching each other the material.	"Yes D is probably whatever the figure that they say starting 6 years from now but its only 5periods working here but it must be in the backtrack of the 5 periods.."(Brad talk).

Incidences of higher order thinking

Although three of the pairs spent half their time or more, in higher order thinking, it was felt that more student time should have been spent in higher order thinking. Part of the reason for the lower than expected number of incidences could have been the fact that the program was very procedurally oriented and therefore there was a high incidence of lower order talk. Analysis of the time spent in each facet of higher order thinking highlights the fact that students did not allocate as much of their talk time to grounding their new knowledge with existing knowledge as had been expected. One pair also spent very little time in planning and strategic thinking, and another pair did not coach each other as much as the other three pairs.

Table 4. Percentage of time spent by pairs in Higher Order talk

Pair Number	Planning /Strategy	Uncertainty	Predicting/ Imposing Meaning	Multiple Perspectives	Coaching	Total time spent in HOT
1	12	8	36	8	4	68
2	12	4	26	5	5	52
3	19	8	21	1	1	50
4	4	15	21	2	6	48

Although the learners were crafting solutions to problems, leading to higher order talk, building more problems into the program would increase the levels of planning and strategic thinking.

The students' talk gradually took on more higher order aspects as students became absorbed by the content and began planning their investment strategies. The degrees of higher order talk varied between the four dyads, as did the incidents that triggered it. These triggering events varied from relating real world events to the program's events, relating new information back to old learning acquired in other units, judging new information and projecting outcomes of decisions. The incidence of coaching also occurred to various degrees, although only one pair utilised it in a very limited way.

The dyads tended to have fairly different examples of higher order talk, with Pair 4 doing very little planning/strategic thinking (2%) and Pair 3 doing 19%. On the other hand, Pair 4 spent quite a lot of time (15%) clarifying statements and 21% of their time predicting and imposing meaning. Pair 1 spent the longest percentage of time on prediction (36%) and also the longest percentage of time on establishing different perspectives (8%). Pair 4 spent the most time accessing the on-line support and help (6%) which is perhaps reflected in their monetary results and also some of their comments about their lack of comfort with the program theory. A comparison of the time spent and totals profits accumulated with the degree of lower and higher order talk show a clear correlation. Pair 1 who had the highest percentage of higher order activities made the most profit, and this correlation holds true for the other three dyads. It also holds true for the time spent in the program with the exception of Pair 2 who spent longer in the program than Pair 1 but made less money.

Table 5. Comparison of lower and higher order activities with time spent and total profits made

Pair Number	Lower Order Activities (%)	Higher Order Activities (%)	Time spent in program (minutes)	Total profit ($)
1	32	68	103	39,345
2	48	52	112	35,239
3	50	50	101	23,500
4	52	48	92	22,080

Summary and Conclusions

It is clear from this study that the use of well designed interactive microworlds leads to learner cognitive engagement which in turn promotes greater degrees of concentration for longer periods of time. Further, if well designed, a program will drive learners towards greater levels of higher order thinking which in turn will assist in the ready attainment of implicit goals set by the program itself and explicit goals personally set by the learners. The use of the game and its motivating and engaging factors created an environment that resulted in high levels of higher order thinking, through triggering events. The program provided information and data from various perspectives and sources and facilitated a real connection between that information and information and learning already possessed by learners. The program's materials encouraged and indeed required, learners to judge and assess the credibility of potentially conflicting information, and to develop strategies to resolve those conflicts, to clarify issues, to solve problems, to experiment, to think strategically and critically, to sift information, to predict and impose meaning and to make judgements and decisions in spite of apparent contradictions.

The materials within the program were written to be understandable, interesting and relevant, not isolated from reality, and attempted to link theory to practice by requiring the application of content. In other words, the program attempted to focus on the functional context of acquired knowledge through the integration of skills in an authentic and realistic manner and setting. In an attempt to minimise the level of lower order thinking, which requires by definition, little sustained mental effort, the program was designed in such a way as to reduce the level of operational mechanistic tasks and allowed easy flow, exploration and ready access to information. In order to further reduce the levels of lower order thinking, an increase in problem solving could be encouraged by providing an increased opportunity for reflection, providing cognitive scaffolds to move learners more quickly to levels of higher order thinking, and by creating cognitive dissonance in both teaching materials and strategies.

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Virtual Environments for Education at NDSU

B.M. Slator[1], P. Juell[1], P.E. McClean[2], B. Saini-Eidukat[3], D.P. Schwert[3], A.R. White[4], C. Hill[5]

Departments of Computer Science[1], Plant Science[2], Geosciences[3], Botany/Biology[4],
North Dakota State University, Fargo, ND 58105

Mathematics and Computer Science[5],
Valley City State University, Valley City, ND 58072

Abstract

WWWIC, the NDSU WorldWide Web Instructional Committee, is engaged in developing a range of Virtual Environments for Education. These projects span a range of disciplines, from Earth Science to Anthropology, and from Business to Biology. However, all of these projects share a strategy, a set of assumptions, an approach to assessment, and an emerging tool set, which allows each to leverage from the insights and advances of the others.

Introduction

The NDSU World Wide Web Instructional Committee (WWWIC) is currently engaged in several virtual/visual development projects: three are NSF-supported, the Geology Explorer (Saini-Eidukat, Schwert, and Slator, 1998; Slator et al., 1998; Slator, Schwert, Saini-Eidukat, 1999; Schwert, Slator, Saini-Eidukat, 1999), the Virtual Cell (McClean, 1998; White, McClean and Slator, 1999) the Visual Computer Program and the ProgrammingLand MOO (Hill and Slator, 1998 Slator and Hill, 1999). These have shared and individual goals. Shared goals include the mission to teach Science structure and process: the Scientific Method, scientific problem solving, deduction, hypothesis formation and testing, and experimental design. The individual goals are to teach the content of individual scientific disciplines: Geoscience, Cell Biology, Computer Science.

In addition, WWWIC is applying what has been learned in Science education to new domains: history, microeconomics, and anthropology. Further, WWWIC has active research projects in two highly related areas: subjective student assessment and tools for building virtual educational environments.

The WWWIC program for designing and developing educational media implements a coherent strategy for all of its efforts. This strategy is to deploy teaching systems that share critical assumptions and technologies in order to leverage from each other's efforts. In particular, systems are designed to employ consistent elements across disciplines and, as a consequence, foster the potential for intersecting development plans and common tools for that development.

Geology Explorer

Geology Explorer is a virtual world where learners assume the role of a geologist on an expedition to explore the geology of a mythical planet. Learners participate in field-oriented expedition planning, sample collection, and "hands on" scientific problem solving. The Geology Explorer world is simulated on an Object Oriented Multiuser Domain, the Xerox PARC LambdaMOO (Curtis 1992). A text-based version of Geology Explorer was tested in an introductory geology class during the Summer 1998. Results of that test were used to prepare for a larger test in the same geology class during Fall 1998. A graphical user interface to the Geology Explorer is in the process of design.

To play the game, students are transported to the planet's surface and acquire a standard set of field instruments. Students are issued an "electronic log book" to record their findings and, most importantly, are assigned a sequence of exploratory goals. These goals are intended to motivate the students to view their surroundings with a critical eye, as a geologist would. Goals are assigned from a principled set, in order to leverage the role-based elements of the game. The students make their field observations, conduct small experiments, take note of the environment, and generally act like geologists as they work towards their goal of, say, locating a kimberlite deposit. A scoring system has been developed, so students can compete with each other and with themselves.

The Geology Explorer prototype can be visited at
http://www.cs.ndsu.nodak.edu/~slator/html/PLANET/

Virtual Cell

The Virtual Cell (VCell) is an interactive, 3-dimensional visualization of a bio-environment. VCell has been prototyped using the Virtual Reality Modeling Language (VRML), and is to be available via the Internet. To the student, the Virtual Cell looks like an enormous navigable space populated with 3D organelles. In this environment, experimental goals in the form of question-based assignments promote deductive reasoning and problem-solving in an authentic visualized context.

The initial point of entry for the Virtual Cell is a VRML-based laboratory. Here the learner encounters a scientific mentor and receives a specific assignment. In this laboratory, the student performs simple experiments and learns the basic physical and chemical features of the cell and its components. More notably, our laboratory procedures are crafted such that they necessitate a voyage into the Virtual Cell where experimental Science meets virtual reality. As the project progresses, students will revisit the laboratory to receive more assignments. Periodically, the student will bring cellular samples back to the virtual lab for experimentation.

The implementation of the Virtual Cell depends on coordinating three technologies: 1) VRML visualization, 2) Java client and simulation software, and 3) a text-based MOO server. Students use a standard WWW browser to launch a Java applet. The applet provides a connection to an object-oriented, multi-user domain where cellular processes are simulated and multi-user viewpoints are synchronized. The Java applet also controls the agent-based implementation of organic constituents, and launches an interface to the VRML representation of the Virtual Cell, allowing the student to explore and experiment within the 3D representation.

The Virtual Cell prototype can be visited at

http://www.ndsu.nodak.edu/instruct/mcclean/vc/

Visual Computer Program and ProgrammingLand Museum

The goal of the Visual Program project is to provide an environment in which students can study and learn programming techniques. We provide tools to support active learning using visualizations of AI programs. These visualizations include animation, fly-through models and more interactive information models. The ProgrammingLand Museum implements an Exploratorium-style museum metaphor to create a hyper-course in computer programming principles aimed at structuring the curriculum as a tour through a virtual museum. Student visitors are invited to participate in a self-paced exploration of the exhibit space where they are introduced to the concepts of computer programming, are given demonstrations of these concepts in action, and are encouraged to manipulate the interactive exhibits as a way of experiencing the principles being taught.

ProgrammingLand is being developed on the Valley City State University (VCSU) campus as a Virtual Lecture adjunct to introductory programming language classes. Students peruse the exhibits of the museum, reading explanatory text that is displayed when they enter a room. A topic may be covered in one or more connected rooms. In addition to the displayed text there are a number of interactive demonstration objects in the museum that clarify or demonstrate the concepts. One such object is a code machine. It contains a short portion of programming language code and can perform any of the following functions: display the code; display the code with a line by line explanation of the purpose or syntax of each line; or display an execution of the code on a line by line basis. The goal of ProgrammingLand is to facilitate programming language courses, either locally or at a distance. At the beginning of this course the MOO had four wings, each incomplete. One of these was an introduction to using a MOO, each of the other three dealt with the one of the following programming languages: C++, Java and BASIC.

The ProgrammingLand Prototype can be visited at

http://www.cs.ndsu.nodak.edu/~slator/html/PLANET/wwwic-pland.html

Blackwood

WWWIC is in the process of designing a virtual environment to simulate a 19th Century Western town. We will populate this town with intelligent software agents to simulate an economic environment representative of the times. This spatially oriented virtual environment, will borrow freely from historical records and digital images from archives at the NDSU Institute for Regional Studies.

The educational "game" will be one where players join the simulation and accept a retailer's role in the virtual environment. Rather than everyone vying for a portion of the same economic market, roles will be variable and specific. For example, in this simulation players will be purveyors of dry goods, food stuffs, blacksmithing services, mortuary services, saloons and gambling establishments, banks, barber shops, apothecaries, messenger services, news stands, gunsmiths, implement dealers and so forth. Therefore, players will only directly compete against other players with similar roles, or with software agents in the same profession, but not be in instant competition with every other player (Slator and Chaput, 1986).

In addition, the environment will support period-authentic atmosphere in the form of entertainments. For example, the circus might come to town, the weekly train will arrive from the east, a cattle drive will appear on the scene, preachers and circuit judges and medicine shows will pass through, and the occasional crime will be reported.

Virtual Polynesia

WWWIC is in the process of designing an immersive, synthetic environment where students, in the role of anthropologist or trader, step ashore on an island in western Polynesia, in the south Pacific, near the turn of the 19th century. That island, and the culture encountered, is modeled after the Samoan islands at a time a time when Samoan culture was still unaltered by Western goods and ideas. The environment will focus on a small valley and surrounding territory which represent a microcosm of Samoan society. The anthropologist is able to observe and explore the traditional society as it had developed to that time. He/she is also able to witness the contact of cultures as the trader enters the picture. While the environment will be fictitious, it will be based on careful attention to actual Samoan materials and cultural traditions.

Virtual Polynesia is another experiment in creating virtual worlds where more than one role is available to students. In this scenario, he most obvious roles are trader and anthropologist. The trader will visit the culture looking to exchange western goods for items in Samoan culture that would have value in the west. The anthropologist will look to the discovery of cultural artifacts that in some way illuminate our understanding of Samoan society.

The WWWIC Research Strategy

The WWWIC projects are designed to capitalize on the affordances provided by virtual environments. For example, to

- control virtual time and collapse virtual distance,
- create shared spaces that are physical or practical impossibilities,
- support shared experiences for participants in different physical locations,
- implement shared agents and artifacts according to specific pedagogical goals,
- support multi-user collaborations and competitive play.

Specifically, the WWWIC projects each design with the following over-arching principles.

Role-based: Simulated environments enable learners to assume roles in particular contexts and have meaningful, authentic experiences. In the popular culture, this approach is captured in the John Houseman adage, "learning not the law, but learning to think like a lawyer". More formally, WWWIC promotes a learning strategy based on ancient apprenticeship where, in modern terms, the student progresses by "modeling the expertise" of the master. Role-based learning is learning-by-doing, but not the mere goal oriented "doing" of a task. Rather, it is learning-by-doing within the structure of playing a role in context. Instead of simply teaching goal-based behavior and tactical task-oriented skills and methods, the role-based approach communicates a general, strategic, manner of practice (McLuhan, 1964).

Goal-oriented: Goals are important, but within the context of roles. It is through goals that obstacles leading to problem solving are encountered. It is within the local goal framework that techniques and methods are learned and rehearsed. Practice and repetition in problem-solving is how apprentices learn the master's craft. Goals provide problems to solve.

Learn by Doing: When experiences are structured and arranged such that playing a role in the environment illustrates the important concepts and procedures of the simulated domain, students are able to "learn by doing" (Dewey, 1900). Experiences are the best teachers.

Spatially oriented: WWWIC simulations are spatially-oriented to leverage off the natural human propensity to towards physically plausible context. In this way, simulations promote the "willing suspension of disbelief" which in turn reinforces the role-based elements of the environments.

Immersive: The combination of role-based scenarios and spatially oriented simulations is conducive to an immersive atmosphere. The concept of immersion has long been shown valuable in foreign language learning (where, it is anecdotally understood, the key moment arrives when the learner succeeds in reaching the point where they are "thinking in X", where X is French, German, Farsi, or whatever). Immersion, then, is elemental to the concept of role- based learning where it is the strategic thinking of the master the apprentice eventually learns to model

Exploratory: Exploratory simulation means enabling students to pursue their own interests. This approach, usually referred to as User-centered design, promotes a pedagogical environment where learners are self-directed and given the freedom to structure, construct, and internalize their own experience (Duffy, Lowyck, and Jonassen, 1983; Duffy and Jonassen, 1992).

Game-like: The value of play in learning can hardly be over-stressed. Students quickly tire of rigid tutorial systems designed to teach at any cost and at some predetermined pace (Schank, 1991). However, since simulations can be adaptive and responsive, playing a role in a simulation can be fun. Players will throw themselves terrier-like into an environment if it feels like a game. Insofar as possible, educational software should be engaging, entertaining, attractive, interactive, and flexible: in short, game-like (Slator and Chaput, 1986).

Highly Interactive: One major challenge for science educators is to develop educational tools and methods that deliver the principles but also teach important content material in a meaningful way. At the same time, the need for computer- based education and distance learning systems has become increasingly obvious, while the value of "active" versus "passive" learning has become increasingly clear (Reid, 1994).

Multi-user/player: One challenge is to craft role-based, goal-oriented environments that promote collaboration as well as the more easily conceived competition. The answer lies in designing systems where student/players have multiple roles to choose from, and to carefully construct the simulation so that these roles are inherently complementary. WWWIC educational systems are uniformly multi-user, and hosted on the MOO architecture.

Software Agents: Software agents are implemented to exhibit authentic behavior(s) of the following types:

- **atmosphere agents:** an agent that simply lends to the local color. For example, in an urban simulation there might be a street magician, a street vendor, a beat cop, a street sweeper, and so forth; in a museum simulation there might be visitors wandering the exhibits or vendors selling popcorn; on a planet perhaps animals roaming the desert.
- **infrastructure agents:** an agent who contributes in some way to the gameplay: in an urban simulation perhaps a banker, an employee, an advertising consultant, and so forth; in a museum, one might expect a guide; on a planet, another kind of guide.
- **tutoring agents:** an agent that monitors player moves, and visits players to give them advice in the form of expert stories and cases, or in some other way assists players in learning to play. These will represent expertise or past experiences of other players.

Unintrusive Tutoring: A key feature of educational media is the ability to tutor students. In WWWIC environments, tutoring is done through unintrusive but proactive software agents. Agents monitor student actions and "visit" a student when the need arises. Tutors give advice, but they do not mandate or insist on student actions, nor do they block or prevent student actions.

Intelligent Software Tutoring Agents: we implement three different approaches to intelligent tutoring, based on the knowledge available to the tutoring agent.

1. **Deductive Tutors** provide assistance to players in the course of their deductive reasoning within the scientific problem solving required for the accomplishment of their goals. **Example:** intelligent tutoring agents in the NDSU Geology Explorer, which work from knowledge of the rocks and minerals, and knowledge of the "experiments" needed to confirm or deny the identity of a rock or mineral. Three opportunities for deductive tutoring present themselves:
    1. an **equipment tutor** detects when a student has failed to acquire equipment necessary to achieving their goals
    2. an **exploration tutor** detects when a student has overlooked a goal in their travels
    3. a **science tutor** detects when a student makes a wrong identification and why (i.e. what evidence they are lacking); or when a student makes a correct identification, but with insufficient evidence (i.e. a lucky guess)
2. **Case-based Tutors** provide assistance to players by presenting them with examples of relevant experience. This is accomplished by
    - creating a library of prototypical cases of success and failure,
    - treating the student's experience as though it were a case
    - matching the student's case with the library and retrieving the most similar, relevant case for remediation
3. **Rule Based Tutors** provide assistance by
    - encoding a set of rules about the domain

• monitoring student action looking for one of these rules to be "broken"
• "visiting" the student to present an expert dialog, or a tutorial.

Shared Courseware Tools: Creating virtual/visual worlds is an intensive process in terms of pedagogical design, knowledge engineering, and software development. Having gained experience in the hand-crafting of these systems, WWWIC is now in the process of designing and developing an integrated library of software tools to substantially streamline the development of future worlds. These tools primarily support simulation and agent building, and are of the following types:

• **Virtual Abstraction Tool:** Jia (1998) implements a first version of a graphical tool for building abstraction hierarchies in LambdaMOO. This tool enables the creation, deletion, renaming, and recategorizing of objects. Tools of this sort enable content experts to visualize the structure of the knowledgebase and assist with creating the taxonomic structures for representing conceptual knowledge.

• **Virtual Entity Tool:** We are implementing a tool to employ an entity template system with a form-filling interface to enable creation of multiple instances of a category. For example, we will define a template for minerals that specifies the properties indigenous to minerals, and ranges of values associated with each property. Then, a content specialist will create new minerals, quartz, tourmaline, talc, etc., with a graphical form-filling interface where values such as color, texture, and hardness can be quickly and easily selected from menus. This tool is general in that any category of entity (animal, mineral, or vegetable) can be constructed with it.

• **Spatial Environment Tool:** We are implementing a spatial environment tool (i.e. a virtual map building tool) to allow environment designers to graphically create and manipulate spaces in a virtual world. By using a map-like interface, content specialists will decide on the specification of locations, such as geological formations and placement of these in relation to each other.

• **Integrated Virtual World Building Tool:** We are implementing a master tool that coordinates and manages the process of building virtual worlds. This tool supports the implementation of virtual worlds from the ground up, by giving access to the construction tools, and a "surface" view of the world as it develops. For example, content specialists building, say, virtual space for paleontology, will use the **Virtual Abstraction Tool** to create the hierarchy of concepts related to fossils. Then the **Virtual Entity Tool** will be used to create an inventory of fossils in different categories. Meanwhile, the **Spatial Environment Tool** will be used to create canyons and mountains where the fossils will reside. The integrated tools set, which we are calling GUMI Suite (Graphical User-friendly MOO Interface) will support the developer's exploration of the virtual world as they develop it. At the same time, the integrated tool will support the **Deductive Tutoring Agent Tool** (described next), since they operate on the same objects.

• **Deductive Tutoring Agent Tool:** We are implementing a tool to
1. provide a menu of virtual testing equipment and the range of values each produces -- from this a subject matter expert can choose the appropriate instrument-value pairs;
2. provide a menu of substances in the same category, to serve as a template; and
3. check other substances to insure a unique set of plausibly sufficient criteria for each.

These three functions will insure that tutoring is supported on all identification tasks and will have the further benefit of checking for consistency of artifacts in the synthetic world. This tool will be integrated into GUMI-Suite, described above.

The ultimate aim in developing software tools is to support the construction of synthetic environments and move development into the hands of content specialists, teachers, and curriculum developers, rather than computer programmers.

Subjective Assessment: Developing methods for the assessment of student learning are a central element of this research (Slator et al., 1998). Briefly, the assessment goal is to determine the benefit to students derived from their "learn by doing" experiences.

Our assessment strategy rejects the notion of standardized multiple choice tests as an adequate instrument in this pedagogical context. While there are, indeed, facts and concepts acquired in the course of exploration, which are neatly packageable and testable with objective instruments, the effect on student learning in that arena will not be significant, nor would we expect it to be.

Therefore, our assessment protocol is a subjective one that seeks to measure how student thinking has improved. To do this, players are given a pre-game narrative-based survey where they are told short problem solving stories and asked to record their impressions and any questions that occur to them. These surveys are analyzed for the presence of what could be considered "important" domain or problem-solving concepts or procedures.

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http://www.cs.ndsu.nodak.edu/wwwic/

Mixing Media For Distance Learning: Using Ivn And Moo In Comp372

Brian M. Slator and **Curt Hill**
Department of Computer Science and Mathematics and Computer Science
North Dakota State University and Valley City State University
Fargo, ND 58105-5405 USA and Valley City, ND 58072 U.S.A.
www.cs.ndsu.nodak.edu and www.vcsu.nodak.edu

Abstract
A mixed media approach to distance education was developed which combined 1) traditional classroom lectures with Interactive Video Network (IVN) multicasting, 2) WWW-based assignments, notes, and course materials, 3) WWW-based quizzes, 4) assignments turned in, and results returned, using E-mail, and, most notably, 5) a virtual environment modeled on the Museum metaphor, where students explored singly and in groups, developed virtual machines that became part of the Museum's "collection", and interacted with instructors who kept "virtual" office hours. The course was attended by students from two campuses 70 miles apart, and delivered by two instructors, one from a third campus, 60 miles in the other direction.

Introduction

Methods for managing distance education continue to evolve. Interactive Video Networks (IVN) are one method for delivering lecture and other programming to remote locations. The Worldwide Web provides the ability to compose attractive text and image presentations, and has become an increasingly vibrant medium with animation and even video. It is more and more common to find course materials online in the form of syllabi, lecture notes, and reference materials. Recently, more active elements have appeared in the form of online quizzes and simple demonstrations. These two approaches supplement the time-honored methods of distance education: correspondence courses and broadcast media. Most recently, research into the development of virtual environments for education have started to have a limited but highly promising impact.

Approach

There are many challenges, both in terms of developing new approaches to content and curriculum, and in delivering that content to remote learners. This paper describes a curricular experience that combined virtual lecture with virtual laboratory to produce a virtual course. In particular, we combined a Virtual Lecture, using the Interactive Video Network (IVN), with a Virtual Laboratory and Museum of Computer Science, the ProgrammingLand MOO (Hill and Slator, 1998), to deliver both lecture-based and hands on instruction to students in remote locations. In doing so we pursued a particular theoretical approach to this new pedagogy - an approach that stresses the importance of virtual environments, authentic experiences, and active learning. We developed a relatively standard IVN course, but then augmented it with networked, multi-player, simulation-based, interactive multi-media - an educational environment that is both immersive and highly interactive (Reid, 1994).

The ProgrammingLand Museum implements an Exploratorium-style museum metaphor to create a hyper-course in computer programming principles aimed at structuring the curriculum as a tour through a virtual museum. Student visitors are invited to participate in a self-paced exploration of the exhibit space where they are introduced to the concepts of computer programming, are given demonstrations of these concepts in action, and are encouraged to manipulate the interactive exhibits as a way of experiencing the principles being taught (Duffy, Lowyck, Jonassen, 1983; Duffy and Jonassen, 1992).

Locality and Temporality

Virtual classrooms and virtual laboratories will help solve many of the problems facing the modern university: distance learning will become a reality, learner diversity will be accommodated (both in terms of learning styles and life styles), and in many cases the curriculum will become more active, more role-based, more self-paced, and more "learn by doing" than "learn by listening" (Schank, 1994).

It is not hard to imagine a day when the curriculum is taught in both real and virtual laboratories - or to foresee a time when students will take virtual field trips in order to prepare for the real thing. One can also imagine a curriculum that combines physical classrooms with virtual ones: where some lecture material is delivered same time and same place, and other material, employing "time shifting" and "place shifting," is not (see Figure 1).

Time/Place Shifting	Same Time	Different Time
Same Place	**Classroom Lectures** **Pros:** personal, sometimes interactive, **Cons:** inflexible schedule, social pressures, mostly passive learner experience, strictly local audience	**Virtual Environments** **Pros:** self-paced, immersive, potential for active learner experience, programmable **Cons:** high development costs
Different Place	**Live Broadcast (e.g. IVN)** **Pros:** personal, sometimes interactive, recordable for later review, potential for wide (broadcast) audience **Cons:** similar to lecture: inflexible schedule, social pressures, mostly passive learner experience	**Recorded or Broadcast Programming** **Pros:** self-paced (rewindable) **Cons:** non-interactive, passive learner experience

Figure 1: Time and Place Shifting

Recursion

From the first day, and throughout the course (COMP 372: Comparative Programming Languages, a required upper division course), we attempted to stress recursion as a theme. This served two purposes. First, recursion is one of the most difficult concepts in computer science. It is an elegant and abstruse mathematical construct that often baffles undergraduate students. Unlike most other computing concepts, recursion is difficult to teach because of the relatively few common sense day-to-day activities that depend on it, making it difficult to draw useful analogies. And unlike previous generations of computer science curricula, it is common in these enlightened times to introduce recursion as early and as often as possible, in an attempt to reinforce the concept until it becomes familiar and workable.

One of the most productive moments for covering recursion in the curriculum is during a course on programming languages. In this context program execution is viewed from the viewpoint of the runtime environment where all programs are managed in terms of memory allocations and activation records on a runtime stack. From this point of view, recursion is not a matter of infinitely embedded abstractions, but a more concrete matter of pushing and popping activation records from a stack. The stack is a powerful metaphor in computer science, and provides an excellent image for understanding recursion, but understanding stacks requires understanding more fundamental computing concepts, and so stacks are not immediately introduced to beginning students. Ironically, with recursion so early in the curriculum, it is now possible for students to be introduced to recursion before they learn about stacks.

Second, in the interest of approaching recursion from an unusual angle, and in order to motivate the programming assignments in the course, we decided to assign projects that called for building virtual machines that illustrated programming language concepts, as a method of teaching these concepts to others. In other words, the students were asked to learn about concepts in order to build artifacts that would be used to teach those concepts. The virtual course, as we styled it (because of the IVN, WWW, and MOO mix), was about studying programming languages in order to recursively implement museum exhibits in order to teach about programming languages.

Course Components

NDSU COMP372: Comparative Programming Languages, was offered in the Summer of 1998 during the 4-week session, and was comprised of the following elements.

IVN, The North Dakota Interactive Video Network

The North Dakota Interactive Video Network (ND IVN) is a two-way interactive telecommunications system located at many sites throughout the state. Any combination of two to fourteen sites may be connected together for a single event and several events may occur at the same time. Over 25 specially equipped telecommunications classrooms and conference rooms link the 11 North Dakota State University System campuses, the state capitol, 5 tribal colleges in ND, and 25 high schools in the state. In addition, ND IVN has the ability to connect to sites world-wide. ND IVN participants can hear all sites at all times but see only one other site. The Network automatically switches the video to the site that is currently speaking. For the automatic switching to occur, a sound must last about two seconds.

An IVN room is designed to as closely resemble a traditional classroom as practical. Each room had approximately 25 seats. There are two television monitors, one displays the current image and the other the image being transmitted from this location. Each student has a microphone on their table. When a student speaks, then the image from that location is broadcast to the other locations. Thus a reasonable conversation can be carried out; however, the originating site can not tell if their image is being transmitted or not. An instructor can also transmit computer images or the display of a paper that then functions like a blackboard. In this particular course, there were four such sites: two on the NDSU campus, one on the UND campus and one on the VCSU campus.

WWW Syllabus and Assignments

All pertinent documents, such as the syllabus and assignments, were posted on web pages. In most classes this is a courtesy to students. In this course it was a requirement since none of the locations were within 50 miles of each other.

WWW Exams

The WWW test system was developed at NDSU for multiple choice tests on the web. It is similar to many other such test-giving systems. A student may log in by registering their name and obtaining an ID. They may then take a test during a particular window of time, which was usually from Friday after class to Monday before class. On completion of the test they were immediately given their resulting score. An instructor could gain access to enter a test, modify a test or obtain class scores. Any common web browser could be used.

E-mail

In such a situation e-mail becomes a critical communication form, since distance keeps face to face conversations at a minimum. E-mail was used for a variety of situations in this course. Assignments that were not MOO based were handed in through e-mail, with the program and other documentation as an attachment. The time stamp of the e-mail determined whether the item is on-time or late. MOO assignments were handed in by e-mail that announced its completion and specified the object numbers of the finished products. Many of the office visit situations were also handled with e-mail, sometimes more easily than a real visit; questions could be answered and programs could be examined. For example, it is often easier to attach an example program to an e-mail than it is to put it in the students hands in a visit, moreover it is much easier for them to run it later. The time delays of this approach leave something to be desired, but this is remedied by virtual office hours as discussed below.

The importance of E-mail made it crucial that both authors processed all e-mail several times a day. The course had a very short time duration, just four weeks. It was imperative for students to receive quick response to e-mail; and three exchanges with a single student in a single day was not uncommon.

The ProgrammingLand Musuem

ProgrammingLand is a MOO (Curtis, 1992) being developed on the VCSU campus as a Virtual Lecture adjunct to introductory programming language classes. The paradigm employed is that of a museum where students examine exhibits, reading the explanatory text displayed on the walls of each room. In addition to the displayed text there are a number of interactive demonstration objects in the museum that clarify or demonstrate the concepts. One such object is a code machine which contains a short segment of programming language code and can display the code; display with line by line explanations; or display a line by line execution of the code. ProgrammingLand augments programming language courses, either locally or at a distance. At the beginning of this course there were four wings under construction. One of these was an introduction to using a MOO, each of the other three dealt with the one of C++, Java or BASIC.

This approach to a MOO has much in common with many web oriented approaches, with some differences as well. A room in a MOO corresponds to a single web page. The MOO is exclusively text-based while a web page can augment the text with various multimedia objects. However, every room of a MOO is also a chat room and users of the MOO are aware of the presence of others in the room or in the MOO, unlike web pages. The MOO keeps more and better server side records of the students and their actions. The MOO server code actually has a web interface, but using it loses many of the interactive advantages of the MOO.

Three assignments in COMP372 were completely MOO based. The first was a trivial exercise in MOO navigation. They were to find an object, which was called the totem pole. When they found it, that fact was marked on their MOO user ID. The purpose of this was so that the students could explore the MOO and see how it was arranged and how exhibits conveyed the desired content. In the second assignment each student was given a LISP function. Students had to build an instructional suite of rooms about their particular function. They were to reinforce their learning by teaching others in the context of the MOO. The third MOO assignment was to create an interactive machine that demonstrated their particular LISP function. This gave them some unique insights into their function, but also the object oriented script of the MOO. The machine in question took one of several function calls and results and verified that the function did indeed produce the stated output.

Since every room of a MOO is a chat room, the students interact with each other and the instructors in the MOO. This suggested the concept of virtual office hours. Each instructor would guarantee that they would be in the MOO at a particular time. Any student with a question or problem could then go and have a real time conversation with the instructor. If that conversation involved a MOO project, then it was a simple matter to visit the room and give what ever help was needed. This approach is not quite as personal as a face to face meeting and it does tend to test the typing skills of the student, but is a solution to the distance problem.

Textbook

The textbook was Concepts of Programming Languages (3rd Edition) by **Robert W. Sebesta**. Published by Addison Wesley, 1996, ISBN 0-8053-7133-8.

Course Details

This course was a typical Junior level Programming Languages courses for Computer Science majors and minors. The first author had taught the course in previous terms, using a MOO. However, a number of wrinkles were requested by the administration. There was some demand for the course on another campus of the NDUS system, so it was requested that the course be taught over the Interactive Video Network (IVN). The course was to be taught in a four-week session, but the number of contact hours available on IVN was three hours short of what was needed for a three hour course. These constraints provoked us to use a strategy not previously used by either of us. The content materials would come from lectures delivered by IVN and the student's offline reading of the textbook. Tests would be delivered through a World Wide Web test system developed at NDSU. All assignments and related material, such as the syllabus, would be available on a WWW page. Conventional programming assignments were done on a separate minicomputer using a LISP interpreter and handed in via email. The recursive learn-by-teaching approach was used, by having students generate lessons inside the MOO.

The course was completed over the course of four weeks (actually, 18 class meetings), and was composed of the elements just listed. Lectures were multicast daily by the first author from an instrumented IVN classroom on the NDSU campus. There were several students in that IVN room, several more in an IVN classroom across campus, and a handful in another IVN classroom on a campus 70 miles to the north. In addition, the second author participated from another IVN location 60 miles to the west. There were 50 students altogether. This technology, described above, is relatively solid and caused few problems (there were, however, occasional audio anomalies, where sudden bursts of static or other noise would be emitted, and there were times when the voice-activated nature of the two-way audio communication was awkward, as sometimes disembodied voices would emanate over the transmission but the accompanying video would never arrive).

The course syllabus was posted at a website online, and reading assignments (both from the text and from online sources), and homework assignments were posted on that site too. In addition, the details of the homework assignments, as well as information on how to negotiate the pitfalls of electronically submitting homework.

Although hosting the course on the Interactive Video Network, and posting the syllabus on the WorldWide Web were steps in the virtual direction, the technologies of the Internet were employed in even more interesting ways than that. In particular, exams were held outside of class and administered over the

Web. Tools for creating these online quizzes were provided by the NDSU Multimedia Center, but they were experimental and proved problematic. Uploading quizzes was painfully time consuming and fault-intolerant. Some students complained about not being able to re-take a quiz if they lost their connection, and there were a few anomalies in grade reporting that had to be corrected by hand. However, the technological difficulties with online quizzes were not extreme.

The pedagogical difficulties with online quizzes were a little more profound, because of the offline, self-paced nature of the Web. In this class, tests were posted on Friday and students were given until Monday evening to complete them. This unstructured, unproctored protocol meant students could take quizzes at their leisure with their textbooks open on their lap. As a consequence of all these factors, quizzes were painful to implement and were relatively weak indicators of student progress. Hence, quiz grades were quite high on average.

There was no attempt made to conceal that this approach was as new to the authors as to the students. It was perceived that they responded well and entered into the adventure. This did require flexibility when various technical problems occurred. In the end, the students rated the class highly (see below).

Local Context

The NDSU World Wide Web Instructional Committee (WWWIC) is currently engaged in several virtual/visual development projects: three NSF-supported, The Geology Explorer (Slator et al., 1998; Saini-Eidukat, Schwert and Slator 1999; Slator, Schwert, Saini-Eidukat, 1999; Schwert, Slator, Saini-Eidukat, 1999), The Virtual Cell (White, McClean, Slator, 1999), and The Visual Computer Program, as well as others. These have shared and individual goals. Shared goals include the mission to teach Science structure and process: the Scientific Method, scientific problem solving, deduction, hypothesis formation and testing, and experimental design. The individual goals are to teach the content of individual scientific disciplines: Geoscience, Cell Biology, and Computer Science.

These projects are designed to capitalize on the affordances provided by virtual environments. For example, to

- control virtual time and collapse virtual distance,
- create shared spaces that are physical or practical impossibilities,
- support shared experiences for participants in different physical locations,
- implement shared agents and artifacts according to specific pedagogical goals,
- support multi-user collaborations and competitive play.

Summary

The combination of IVN, WWW, and MOO proved to be quite effective and stronger than any of these alone. The use of the MOO greatly enhanced the effectiveness of the course by reducing the perceived separation of student and instructor. Student evaluations of the course were quite high, with 92% of the students responding rating the quality of the course as either above or much above average. Similarly, 88% of the students believed their understanding of the course content was either good or very good.

Future Plans

We intend to conduct a more thorough study of this approach when the course is offered again in the first summer session of 1999. This study will include a survey given at the beginning of the class and follow up survey at the end that attempts to capture student perceptions of this form of distance learning.

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http://www.cs.ndsu.nodak.edu/wwwic/

or the ProgrammingLand Project Page:

http://www.cs.ndsu.nodak.edu/~slator/html/PLANET/wwwic-pland.html

Internet-based Seminars at the Virtual University: A Breakthrough in Open and Distance Education

Birgit Feldmann-Pempe, Computer Science I, University of Hagen, Feithstr. 142, D-58084 Hagen, Germany,
birgit.pempe@fernuni-hagen.de

Silke Mittrach, University of Hagen, Computer Science I, Feithstr. 142, D-58084 Hagen, Germany
silke.mittrach@fernuni-hagen.de

Gunter Schlageter, Computer Science I, University of Hagen, Feithstr. 142, D-58084 Hagen, Germany
gunter.schlageter@fernuni-hagen.de

Abstract: The Virtual University is an Internet-based learning environment that includes all aspects of a university, developed at the University of Hagen. The project is experimenting with and evaluating different forms of teaching and learning. A new form of teaching is the virtual seminar. Our experiences show that the virtual seminar is leading towards a major quality improvement. in open and distance education. Learning activities are changing, the alternation of receptive and active-expressive activities is possible. The seminar develops into a new and constant cooperation and communication process.

1. Introduction

As life-long learning is getting more and more essential in professional life, learning via Intra-and Internet will more and more succeed, mainly with the increase of open and distant learning [MITT98a]. The benefits of distance education, time- and location independence and the advantages of the Internet (fast information, easy communication and co-operation possibilities) are combined in the project virtual university. A prototype with about 4.000 students is running since 1996 at the University of Hagen
The Virtual University [BM96] of the University Hagen is a virtual university system that integrates all functions of a university into a complete, homogeneous, extensible and cost-effective system with an easy to use and intuitive user-interface. The main menu of the Virtual University [Fig. 1] offers the functions:

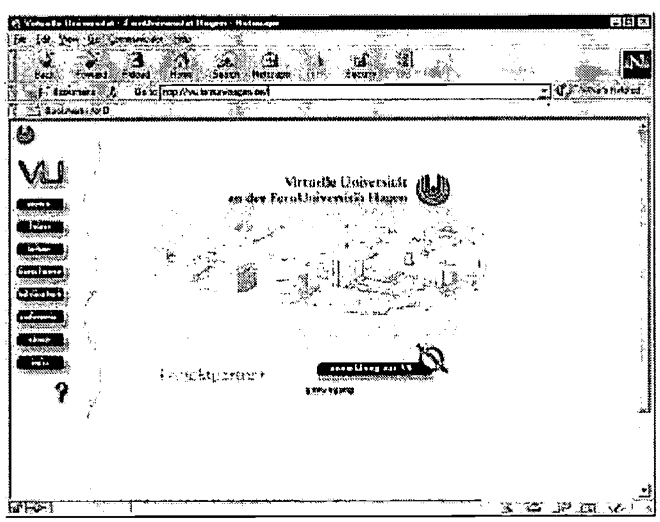

Fig. 1: Home page of the Virtual University, http://vu.fernuni-hagen.de

education - for participation in courses, seminars, practical training and exercises; news - a campus wide blackboard containing all sorts of up-to-date information relevant to the users of the Virtual University; office - the component including administrative functions; research - offering access to all research-related activities in the university; cafeteria - a forum for social contacts between students; library - offering access to both traditional and digital libraries; information - a menu containing general information about the university; and shop - offering all material that can be purchased from the university.
This paper aims to describe the different phases of traditional and virtual seminars in open and distance teaching at the University Hagen in correlation with the use of different communication tools, objectives, and learning activities. The major breakthrough is attributed to the multitude of communication and cooperation facilities given in the Virtual University. The differences and the results of these differences are described in part 3 of the paper, the fourth part gives some insights our experience with virtual seminars. In the summary and prospects (part 5) recommendations for doing successful virtual seminars are given.

2. Conventional Seminars and Virtual Seminars

The seminar is traditionally an important teaching method in higher education, also at the University of Hagen, which is specialized in open and distance education. The main objective of the seminar as teaching form is to maintain and acquire scientific work prospective and to present and discuss the results of this work. So far, these objectives of a seminar were only partly fulfilled by the conventional seminar, because a continuos communication-, cooperation- and learning process is hardly possible.
The virtual seminar is much more like a seminar in presence education. Moreover the communication-, cooperation- and learning process is much more structured and more disciplined than in presence education.
The following part describes the different phases of conventional and virtual seminars at the University of Hagen out of a student's perspective.

2.1 Traditional seminar at a distance university

The conventional way to take part in a seminar is the following:
Students get their topics by mail, work out their contribution, travel to the university and present their contribution in the presence phase (two days). There are only three seminar phases (introduction, elaboration and presence phase), with nearly no cooperation or alternation of different learning activities. This way causes different problems:

- students have rarely contact to tutors, students are working alone mostly
- little communication between the students
- discussing questions and problems is time-consuming
- students can not participate in the selection of topics
- groupwork is nearly impossible
- nearly no cooperation / arrangement between students to deal with overlaps concerning their topics
- there is less alternation in the students' learning activities
- students have to travel
- the presence phase is completely taken up with presentations, there is little time for discussions

2.2 Traditional seminar at a campus university:

The traditional seminar at a campus university seems to be a more communicative and cooperative way to reach a seminar's objectives. But in it's structure the traditional seminar typically is hardly better than the distance seminar. Normally, students do not know each other, are working on alone their contribution with little communication with other students or the tutor. The discussion process is short at best and not very deep, the students usually are unaware of the written contribution of each other.
The lively, interesting, well-structured seminar with only good presentations and very active, cooperating and communicating participants is a rare exceptional case, even though the students are less isolated than in traditional distance teaching seminars.

2.3 Virtual seminar at a distance university:

The virtual seminar is one of various teaching activities at the Virtual University. The Internet services used for such a seminar are email, ftp, news, chat, audio- and video conferencing [BERK97]. Services were individually combined for different seminar phases. There are also mixed forms between virtual and conventional seminars, e. g. only certain seminar phases are assisted by Internet-based tools. In the following only pure virtual seminars are considered.

The average number of participants is about 15 students preparing lectures (either individually or in co-operation with other participants), supported by Internet communication services. Furthermore there are about 40-70 students taking part as so called "passive" participants. These passive participants are having the possibility to take part in the seminar's communication process but are not producing lectures.

Since the beginning of the Virtual University project about six pure virtual seminars have taken place in our computer science department. The way to execute such a virtual seminar is as follows:

Seminar phase		**Communication tools**	**Objective**	**Learning activities**	**Co-operation**	**Time**
Enrolment		Mail, Email (Mailinglist)	Interesting the students for a special topic	None	None	Two months before the term starts
Orientation		WWW, News, Email,	Decision for a specific theme to elaborate during the seminar with student's participation	Receptive and active, expressive	Discussion about the topics with the tutor and other students	four weeks before the term starts
Introduction		News, WWW	Presentation of the participants and the tutor, first introduction in the seminar's theme	Active-expressive and receptive	With the tutor and students	At the beginning of the term
Preparation of Groups		News, Email, telephone	Building of seminar work groups, which will work out one topic together.	Active-expressive	With the tutor and other students	At the beginning of the term
Elaboration	Recherché	News, Email,	Knowledge acquisition about a special topic of a certain theme	Active-expressive	With the tutor and other students	
	Structuring	News, www, Email	Structuring the information, presentation in the newsgroup or www Finding out overlaps to other topics	Active-expressive	Discussion about the structure with the tutor and other students	Six weeks after the term started (average number)
	Correction	Email, news	Correction and revision of the reviewed structure	Active-expressive	With the tutor and other students	Two weeks after Structuring
	Writing	Mail	Final version of the written contribution	Active	With the tutor and other students	Four to six weeks (average number)
	Finish	WWW, news, Chat, Audio- and/or Videoconferencing	Publishing the contribution in the web, discussion	Active	With the tutor and other students	Gradual, two months before the term is ending until
Presence		Personally, or www	Presentation and discussion of lectures	Active-expressive, receptive	With tutor and other students	End of the seminar

Table 1: Seminar phases of a virtual seminar

To summarize the advantages of virtual seminars:

- students have rather good contact to tutors and other students
- continuous communication between the students, throughout all seminar phases
- discussing questions and problems is time- and cost-effective
- students can easily participate in the selection of topics
- building of learning and working groups is possible
- it is possible to find out overlap concerning the student's topics and to provide hyperlinks to each others contribution
- students do not have to travel at all
- in the case the presence phase is taking place, the time could be used for discussions. Furthermore, the time needed to getting to know each other is less than in
- conventional courses

3. Differences

As shown, the main differences are in the use of communication tools and in the learning activities. The virtual seminar is much more structured than a conventional seminar, particularly in the elaboration phase, which is one of the most important phases.
Our experience show, that a well-structured teaching process and a continuing guided learning process, supported by alternating learning activities, are the best guarantee for a major quality improvement. The experiences of virtual seminars could also be used to rise quality of traditional seminars at a presence university.

A short comparative overview:

3.1 Seminar Phases

In contrast to conventional seminars, the virtual seminar is enriched by the phases Introduction and Preparation of Groups. The introduction phase has the objective
to introduce the participants and the tutor to each other, mostly in the seminar's newsgroup, sometimes in the WWW by the help of HTML-Pages.
New is also the preparation of groups. In conventional seminars the group building process was nearly impossible.
Normally, the presence phase is shortened from two days to one, which reduces the costs of overnight stays for the students, but it is also possible to do the whole presentation and discussion phase online in the Web, e. g. by the use of text-chat, audio- and videoconferencing.

3.2 Communication

The conventional seminar uses traditional communication tools, like mail, telephone, fax, etc.. The communication tools in a virtual seminar are Internet based. These communication tools enable the very active communication, co-operation and discussing process. For the first time synchronous communication with several students and tutor is possible in a cost-effective way.

3.3 Objectives

Some new objectives are given in the virtual seminar: The introduction of participants and tutor, the participation of students in defining seminar topics. Furthermore, finding out overlaps with other topics, publishing and discussing the contribution in the web.
For the first time the classical objectives of the seminar as teaching method, to learn to work scientifically, to present and to discuss the results, are given in distance education.

3.4 Learning activities

It is evident that the alternation of receptive, active and expressive learning activities is much better given in the virtual seminar form. Nearly each seminar phase contains all learning activities, in contrast to the conventional seminar form, which comprises only two phases with all above mentioned learning activities.

3.5 Co-operation

Co-operation is hardly possible in the conventional seminar, but one of the most important advantages of virtual seminars, even if the cooperation process is guided by the tutor.

3.6 Time

The term time in virtual seminars is structured in greater detail, especially in the elaboration phase. Giving feedback to the students is fast and easily possible, for the students the possibility to give feedback to each other is really new. The visualization of the working process in the elaboration phase is an important step to break through the student's isolation. Over-all the virtual seminar is a time-effective teaching method.

4. Some Experiences

Since the Virtual University started (in winter term 1996/1997) about six completely virtual seminars have taken place.

The experiences made with virtual seminars in the project Virtual University are throughout positive. A user's survey of participants of the virtual university in spring 1998 showed, that the intensity of the contacts virtual seminars is much better than in conventional seminars, also the building of work and learning groups.

Furthermore, most of the students were of the opinion that the discussion quality is higher than in conventional seminars. The majority of the students scored the offer of online-seminars with "very useful" [MITT98b].

Another aspect is the dropout rate, always a problem in open and distance teaching. The drop out rate in the virtual seminars was significant less than in conventional seminars.

Robin Mason [MASO94] describes related results in the context of synchronous communication.

5. Summary and Prospects

The virtual seminar allows a well-structured teaching process with alternating receptive and active-expressive learning activities which promote the student's learning success.

In contrast to conventional seminars a continuing learning process is now possible, the discussions, taking place in the Internet are much more structured and disciplined than in the conventional seminars presence phase.

Internet based communication tools enable the very active communication, co-operation and discussing processes. The forming of groups and learning together are new and highly valuable activities for the distance students.

By working out the seminar contributions in HTML it is for the first time possible to have seminar contributions as a homogenous hypertext, to avoid overlapping of topics and learn from each others contribution.

The successive publishing of the contributions enables the student to discuss continuously about certain topics, in contrast to discuss all contributions at one time. Furthermore, the student is able to concentrate on the main thesis of his/her presentation, because of the most others know his/her work. In addition, the students are able to learn from each others work.

Criteria to give a successful virtual seminar

Moderation process
Critical for the success of a virtual seminar is the moderation process. It is necessary to look regularly in the seminar newsgroup, to read daily emails, to bundle frequently asked questions and to answer quickly to the students' questions. In the beginning of the seminar many messages will arrive, but then their number will decline, because the students prefer to communicate with each other, using the newsgroup and other communication tools.

Structuring and Support
As in conventional seminars it is helpful for the students, if the seminar themes are clearly structured and support is given for the literature research and outline of the contribution (even if the contribution should have the HTML-format).

Discussion process
The system with active and passive participants is useful to reach the "critical mass" of students to have a rich discussion process.

Communication and cooperation
The cooperation process should be guided by the tutors and the tutors should have a look at the students communication styles and topics.

Access control
In the Virtual University the newsgroups have an access control (like the Virtual University itself) to protect the students communication process.

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Integrated and Remotely Accessible Laboratory Environment for Embedded System Engineering Education

Tony Manninen, Research Assistant, Raahe Institute of Computer Engineering, Finland, tmannine@ratol.fi
Eino Niemi, Project Manager, Raahe Institute of Computer Engineering, Finland, eino.niemi@ratol.fi
Jouko Paaso, Professor, Raahe Laboratory of Oulu University, Finland, jpaaso@tietoteku.ratol.fi

Abstract: A Technology Development Centre of Finland (Tekes) funded ProTest project has been researching and developing methods and systems intended for improving the testing performed within embedded systems product development. The Raahe Institute of Computer Engineering being one of the project participants constructed and demonstrated the embedded system laboratory environment, which can be used as part of everyday engineering education activities. In this paper, the remotely accessible laboratory environment, which improves the possibilities and flexibility of engineering education in the field of embedded system design and development, is presented. In addition to this, the demonstration of the environment with engineering students, and the corresponding results, will be described and analysed.

Introduction

The ever-increasing need of the electronics industry for engineering professionals, and the extensive growth of markets in the field, require new and more efficient methods for training engineers. In order to keep up with the rapid development pace, educational and training institutes must drastically change and modify their existing laboratory systems, which are often much too expensive for being truly cost-effective. The high-cost equipment needed for modern applications require efficient usage and a high utilisation percentage in order to guarantee manageable operation costs. Even in the most optimistic situations, the expenses will probably still be too high for smaller training institutes [Paaso and Manninen 97].

Keeping the aforementioned aspects in mind, the Technology Development Centre of Finland (Tekes) funded ProTest project has been researching and developing methods and systems intended primarily for improvements in product development testing. The Raahe Institute of Computer Engineering (RATOL), being one of the project participants (together with Nokia, Elektrobit, and TH Engineering), concentrated on the embedded system test environment, which could be used as part of the everyday engineering education activities. With close co-operation between RATOL and the Raahe Laboratory of Oulu University, the experiences from the IDEALS project (EU Telematics Applications programme) could be utilised in a more hardware-oriented environment [Manninen and Paaso 98, Ideals 95].

Remote access or tele-operating systems provide new possibilities for cost-effective usage. Tele-operating systems enable location-independent control, as well as monitoring and result analysing of the laboratory work and system. The students or trainees may, thus, access and operate a fully equipped high-tech laboratory, regardless of their current place of learning, which could be a computer class room, work place, or even the trainee's home. This would mean less travelling and a more flexible usage schedule for the students. In addition, the remote access systems provide smaller institutes the possibility of using external laboratory facilities rented from other organisations. With this kind of arrangement, the high-end equipment would have a higher utilisation percentage, which in turn would reduce the operational costs even for the institutes that have acquired the systems [Wunnava and Hoo 96, Referowski et al 97].

The current lack of human resources in the field forces the institutes to search for solutions that would require the least possible amount of personnel. Modern laboratory facilities, e.g. micro-controller development tools and emulators, are very complex and usually require constant monitoring by Laboratory Engineers. The laboratory facility centralisation model (Figure 1) will enable integrated support and services, while the remote access systems will provide support-on-demand even for the remotest locations.

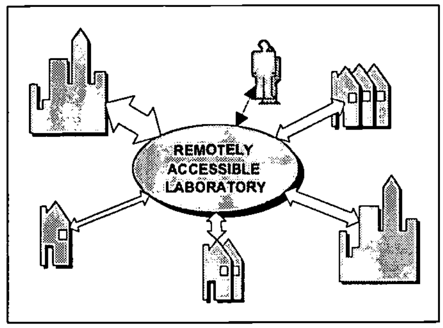

Figure 1. Laboratory Facility Centralisation Model

In this paper, the laboratory environment, which improves the possibilities and flexibility of engineering education in the field of embedded system design and development, is presented. In addition to this, the demonstration of the environment, and the corresponding results, will be described and analysed.

Laboratory Environment

The design and development of the remotely accessible laboratory is based on two factors: automation and tele-operation. Automation enhances the laboratory work process by providing learners with a set of tools and procedures they can use in order to avoid long and tedious routine work. The tele-operation system acts as the remote hands and eyes of the learners, who might be physically located hundreds of kilometres away from the actual laboratory environment.

Both automation and tele-operation have been studied within various research projects around the world. Automated testing is only a partial solution when designing the remotely accessible laboratory. The practical work conducted with a high level of automation, and usually as batch-jobs, prevents the learner from getting a real hands-on experience on the subject [Knight and DeWeerth 96]. However, the technical demands of versatile high-tech tele-operation systems may exceed the budget and expertise of most educational institutes. Even if the system itself could be achievable, the networks and applicable bandwidth will probably create problems when attempting to transfer high-quality and immersive tele-presence environments to end-users. The optimal solution would be, first, to combine some of the features from both of the factors (automation and tele-operation), and then to construct supportive solutions to enhance the quality and usability. For example, virtual tele-operation with the help of a 3D model of the remote system is one approach to the problem [Rastogi et al. 96].

The laboratory environment constructed in the Raahe Institute of Computer Engineering includes a complete and remotely accessible development and testing system, which is automated with the aid of scripting language. The modular system is built mostly from standard components so that it is easily modifiable based on the needs of various laboratory projects. Figure 2 illustrates the layout and infrastructure of the remotely accessible laboratory environment. The testing facility included in the environment is developed with educational requirements in mind, in order to guarantee the easiness of concrete usage within the areas of training and learning. Furthermore, the system is integrated in a way that it can be easily moved to another location.

The testing laboratory environment consists of the system constructed specifically for verification and demonstration. The central components of the system are the unit under test, robot, video camera, and the measurement and data transfer equipment connected to the control computer. In this case, the unit under test consists of a Lauterbach emulator, an Intel196 micro-controller, and a Bytronics card attached to the controller.

The remotely accessible laboratory environment is connected to the outer world through two Ethernet cables and one power cord. The transmission and access to the system is managed through the controlling computer, with the aid of remote access software.

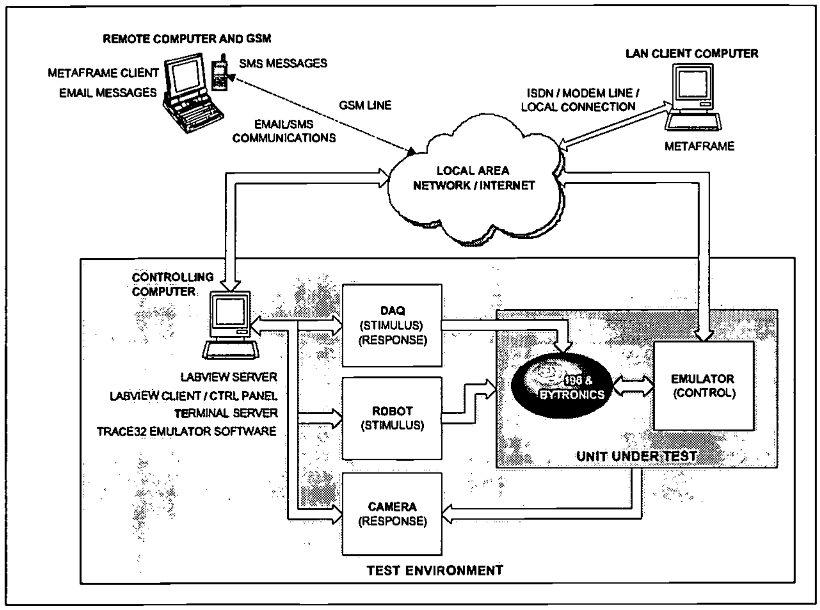

Figure 2. Remotely Accessible Testing Laboratory

The control computer contains all the software needed to operate the system locally and remotely. The Windows NT Server 4.0 (Terminal Server Edition) acts as a platform for the LabView software, which in turn manages the robot, camera, Input/Output devices, and the emulator control. The remote access is accomplished by operating the control computer from an external PC containing either Terminal Server Client or Windows MetaFrame software. Figure 3 represents the desktop view of an external PC, which is remotely accessing the control computer, and thus, all the resources manageable through that computer. The main user interface consists of main LabView test engine control, manual robot control, and the video camera view from the laboratory environment.

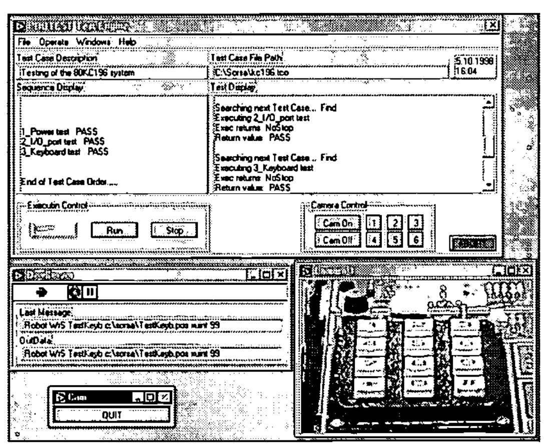
Figure 3. The Desktop view from the remote control and monitoring terminal.

Verification Demonstration of the Environment

In addition to the evaluation with end-users, a wide variety of heuristic evaluations from experts in the field were used to identify the possible flaws of the system. These evaluations were combined with the system demonstration used to verify the features and functionality of the system. Within the verification demonstration of the remotely accessible laboratory environment, the possibilities to use and control the environment through tele-operation have been widely presented and tested. These possibilities include, for example, alarms in exceptional situations, tele-operation as a recovery procedure (through low bandwidth communication network using a GSM cellular phone, modem and laptop PC), using the robot for mechanical stimulus and as a remote hand (power on, keyboard input, etc.).

The tests and procedures included in the verification demonstration are divided into four scenarios, which are intended to model real usage cases. Each demonstration scenario presents a different aspect of using and accessing the laboratory environment. The various aspects include bandwidth-restricted usage, high level of automation, and high level of manual operations. The underlying engine with the accompanying software and hardware is the same throughout the demonstration scenarios.

Scenario 1 - High level of automation: Illustration of a situation in which the user of the environment is actually operating the system from outside the laboratory premises. With this kind of arrangement, the end-user can, for example, work at the same time while running automated testing sequences. The basic principle in this scenario is the high level of automation within the laboratory environment, and the possibility to control and monitor the system outside the laboratory. Within the demonstration, the connectivity and the usability of the system through the local area network were tested and evaluated.

Scenario 2 - Tele-operation: The emphasis of scenario 2 is on remote operations and on the control of the laboratory environment with the aid of various supporting devices. The scenario is an illustration of a situation in which it is impossible to use the highly automated procedures, and thus, it is compulsory for the end-user to have enhanced manual control of the system. The remote-controlled robot and camera act as the hands and eyes of the user. Figure 4a illustrates the basic structure of the system within scenario 2. The demonstration includes normal batch operations, which are halted by random exception occurring from the unit under test or from the environment itself (e.g. a power off situation).

Scenario 3 - Mobile: Demonstrates the most advanced remote usage situation using wireless data transfer and place-independent control and monitoring possibilities of the laboratory environment. The case illustrated in scenario 3 includes responding to the stimulus created by an exception, obtaining information from the status of the system, and executing operations to recover the procedure from outside the laboratory. The interface between the end-user and laboratory environment consists of a GSM mobile phone, a laptop computer, and GSM connection. Figure 4b illustrates Scenario 3. The demonstration includes responding to an SMS message transmitted by the laboratory environment and the laptop-based monitoring and controlling of the system.

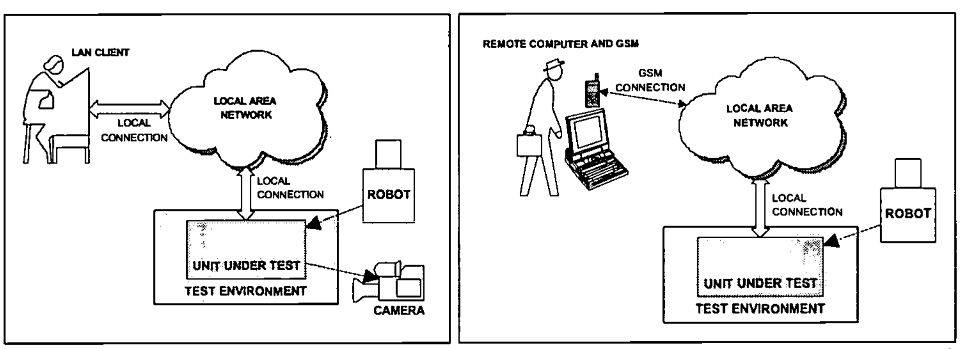

Figure 4. (a) Remote control and monitoring with the aid of a camera and robot. (b) Remote access through wireless communication network (GSM).

Scenario 4 - Tele-teaching through remote expert services: Illustration of a situation in which it is important for the users working in the laboratory environment to get assistance or advice. In order to save on travel expenses, the system presented in scenario 2 may be enhanced with audio and/or video communication equipment, and thus, provide the remote expert with an adequate feeling of being on site. A large proportion of the system features will thus be accessible for the expert who, with the aid of the communication system, will be able to interact with the system as well as with the users working within the laboratory. Figure 5 illustrates the demonstration of scenario 4.

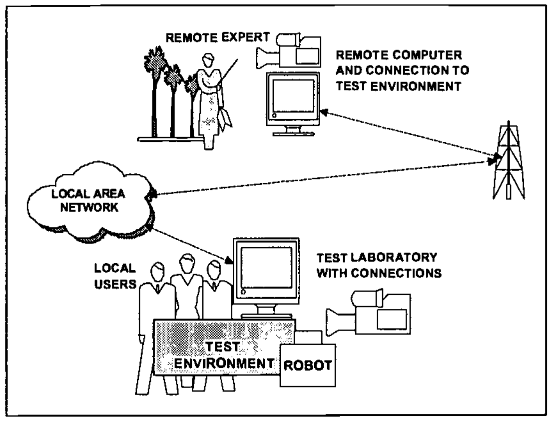

Figure 5. Tele-teaching through remote access and video conferencing.

Experiences with Engineering Students

The aforementioned integrated and remotely accessible laboratory environment has been demonstrated and tested using real end-users in the Raahe Institute of Computer Engineering between January 1999 and March 1999. The demonstration included a total of eleven B.Sc. students (with various levels of previous experience) who completed the assigned laboratory work as part of their compulsory studies. The assignment (30 to 60 minutes in duration) included programming, testing, problem solving, and analysing of the micro controller (Intel 196 with Lauterbach emulator). The objectives of the task were set in a way that students were forced to exploit all features of the system in order to achieve satisfactory results.

The evaluation consisted of scenarios 1 and 2, with scenario 4 downscaled to meet the available resources (the videoconferencing was changed to a mobile phone connection). The students completed their assignments by working in a remote access laboratory with no possibility for "on site" operations. The actions of the students were monitored in their work place as well as within the laboratory. Furthermore, a set of questionnaires was used to collect feedback from the users. Figure 6 outlines the demonstration arrangements.

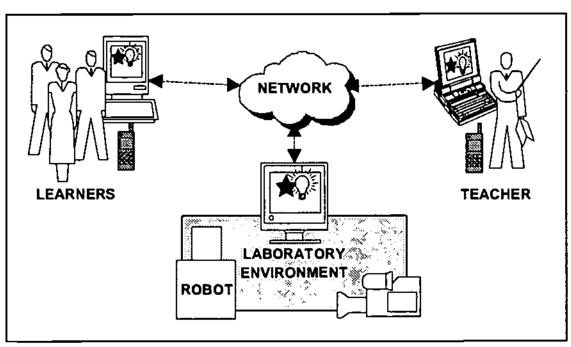

Figure 6. Demonstration and evaluation environment of the remotely accessible laboratory.

The questionnaires were used to gather information about the expectations, experiences, and opinions of the end-users. The questions were divided into the following categories: user background (previous experience), functionality (system performance), and comparison (with the traditional laboratory work).

The analysis of the questionnaires indicates positive feedback from the users. From scale 1 to 5 in a total of 26 system evaluation questions, the lowest average score was 3.1, while 80 per cent of the questions had an average above 3.6. The top 20 per cent of the questions had averages from 4.5 to 4.9. From the averages and from the distribution of the scores within individual questions, the following observations can be made:

- The system, with its current implementation, does not prepare the students for practical work as well as was required (average 3.1), although it may be argued whether the result is actually worse or better than with the traditional laboratory arrangements. Of course, the lack of all the physical elements of the normal laboratory might move the student away from the real world usage.
- The completion of the given assignment was, in the students' opinion, as feasible to accomplish as with the traditional environment (average 4.0). It was even stated that the connection to the teachers was easier to maintain with the arrangement described above (average 4.5).
- Although limited in terms of implementation and usability, the system is far better when compared with the traditional situation with the resulting need to travel to the laboratory facility (average 4.3).
- The students themselves believe in the system and were motivated to exploit its potential also in the future (average 4.7).

Conclusions

The great demand for engineering professionals requires new methods for increasing the output of graduates from universities and polytechnics. One proposed solution to the problem is the integrated and remotely accessible laboratory environment, which enables more efficient learning and practical working, even in sparsely populated areas.

The laboratory environment constructed in the Raahe Institute of Computer Engineering has shown that it is possible to create remotely accessible laboratories with current standard techniques and components. Furthermore, the verification and demonstration of the environment result in a large number of possibilities corresponding to the requirements of the practical learning and training.

The remotely accessible laboratory can be constructed, to a certain extent, with readymade and standard components. However, a large-scale development and testing environment requires more software and hardware components, which in turn results in problems within the system integration. Even in a small-scale realisation, the major problems encountered were caused by the integration of various software components and hardware incompatibilities. All of the problems can be solved with additional work and further development, so the solution presented is realistic even for smaller educational institutes.

The verification indicates that the end-user of a remotely accessible laboratory environment does not necessarily need high-tech futuristic technology, but merely safer, but applicable, lower-end tools and methods. For example, video conferencing with high quality real-time images would seem to be less favoured than the robust and somewhat inferior connection and interfaces enabling the operating in a remote environment.

The remotely accessible laboratory environment provides more flexibility for everyday engineering training, with time and place independent access possibilities. Furthermore, the fact that the environment is usable anywhere from the network enables cost-effective centralisation procedures and, thus, provides an opportunity for smaller organisations to exploit the features of a modern and high-tech development and testing laboratory.

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Producing CBT Courseware for Software Engineering Education Cost-Effectively – The IDEALS Methodology and System

Jouko Paaso, Raahe Laboratory of University of Oulu, Finland, jpaaso@tietoteku.ratol.fi
Tony Manninen, Raahe Laboratory of University of Oulu, Finland, tmannine@ratol.fi

Abstract: In the education of embedded software engineers there is a need for increasing the graduate output. A substantial amount of re-training and on-the-job training is needed; thus, there should be plenty of flexibility in the teaching arrangements. CBT utilising telematic facilities is the most relevant form of technology in Northern-Finland and the Oulu area, where distances are long, but the telecommunication infrastructure is well-developed. The IDEALS modular training system (MTS) and methodology, for co-operative learning and authoring utilising CBT courseware, are presented in this paper. Concrete results show the cost-efficiency of the methodology and system in the CBT courseware production.

1. Background

The IDEALS project of the EU Telematics Applications programme was co-ordinated by Fraunhofer-IGD in Darmstadt, Germany. There were thirteen partners from Germany, Greece, Portugal, Holland and Finland in the project, which ended on 30 June 1998. The Raahe Laboratory of the University of Oulu, RATOL, was one of the six local training centres (LTC) in the project learning network, and had, as its main task, to co-operatively create and demonstrate the use of the Computer Based Teaching (CBT) courseware (CW) on the topic "Fundamentals of Computer Graphics" for students in Institutes of Higher Education [Paaso 98, IDEALS 95].

In the Raahe Laboratory of the University of Oulu, the ultimate goal for the CBT research, which was based on the IDEALS methodology and system, was the following: *A CBT-based methodology developed for embedded software engineering education will enable:*

1. *to develop, by utilising the telematic multimedia, the desired and pedagogically functional learning model, which is based on the 'learning-by-doing' -philosophy and on individual student profiles, and which originates from the capabilities of graduates required by industry*
2. *to achieve, as a replacement or alternative to the traditional teacher-centric education model, significant flexibility and efficiency improvements in the delivery of teaching*
3. *to bring a significant cost-effectiveness improvement to the production of CBT courseware by means of CW reuse.*

Essential criteria for the developed learning model in the embedded software engineering education were the support for learning, regardless of time and place, individual learner profiles, learning by doing, industrial type teamwork and collaboration (i.e. concurrent engineering and activation to interaction between students), interactivity between the computer and the student, continuous testing of the knowledge level as an essential part of the learning process [Manninen and Paaso 98a]. In the co-operative telematic authoring part, the essential success criteria for the methodology were the reduction of the CBT production effort and the easy maintenance of the CBT courseware. These criteria were validated by applying the developed methodology to a representative course, the *Graphical User-interface Programming* course, in the embedded software area [IDEALS 96].

2. IDEALS Learning and Authoring Scenarios

The basic architecture of the IDEALS Modular Training System (MTS) is presented in Figure 1.

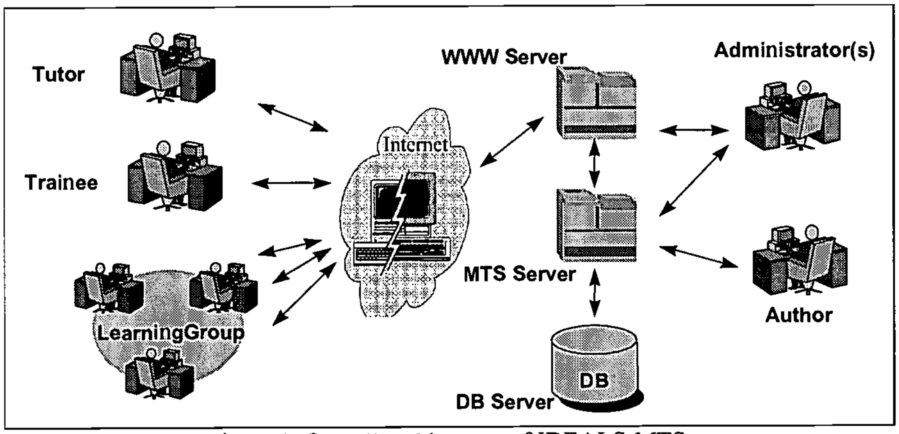

Figure 1. Overall architecture of IDEALS-MTS.

In the IDEALS learning scenario, the following major learning sites supported can be identified:

- remote trainees (individual access to the local training centre, LTC)
- trainees at training service provider (TSP)
- trainees at LTC.

LTCs and TSPs are almost identical in hardware and software. The only difference between them is that LTCs provide management functionality for distributed courseware and administration functionality for users. Each LTC is the owner of a distinct subset of the distributed CW domain. It may also provide copies of CW owned by other LTCs. TSPs provide only copies of CW from LTCs; their purpose is the provision of computing power and CW in close proximity to the trainee's working place. Each LTC and TSP provides a CW domain server and an MTS server. All LTCs are interconnected. Over these trans-European interconnections the LTCs share their CW databases, and, therefore, can be seen as one virtual LTC, giving access to the whole CW domain. Learning can start immediately from the WWW-browser. After login, the trainee can start a new course, resume a saved course, issue a training-on-demand request, or select a learning group. After working on *presentation, exploration* and *test* units, the course status is saved and the learner profile updated. Interactive learning can be added to any type of course usage at any time, either as expert consultation, or by joining a learning group [Paaso *et al.* 97].

An additional important scenario in the IDEALS context is the co-operative authoring of the courseware and final courses. In this scenario, authors located in different LTCs are preparing, discussing, and finalising the common CW domain, using different telecommunication capabilities, such as audio and video conferencing. In order to create a common look and feel for the common CW, IDEALS *style guides* are in use; however, creation of these guides first presumes "base" CW production. Courseware catalogues consisting of the CW module profiling information are available, thus enabling the multiple use of CW.

3. Courseware Characterisation

The target group for the implemented CW on the topic *Graphical User-interface Programming*, was, primarily, students in universities and technical colleges (institutes of higher education, IHE), and also personnel in small and medium sized enterprises (SME). A more detailed target group includes persons who already are able to do programming, e.g. in C++; so, in the course there is no training for programming basics. The course material contents handle Windows-C programming, as a subset of the user-interface programming area. An emphasis area in the course are functional parts, which activate students to learn by themselves (learning-by-doing), and not only follow the course passively. Animations, interactive examples, exercises and versatile hypertext linking support the theory part and make it more illustrative.

Each section of the CW consists of presentation, exploration and test parts, whose total duration and division follow the guidelines agreed upon in the IDEALS consortium, i.e. for presentation 30 per cent exploration 50 per cent and testing 20 per cent:

- In the presentation part, there are typically text-picture-combination presentation pages with hot words (by clicking them sub-windows, which provide users with some specific detail, are opened).
- In the exploration part, the 'Step-by-step' learning principle is applied. The overall learning process of programming is divided into the following four steps:
  1. Assignment Viewing: At the beginning of a new programming subject to be learned, learners are introduced to the final goal, i.e. what they should be able to do after this, in order to obtain an in-depth and clear overview of the assignment.
  2. Virtual Compilations: The *virtual compiler* simulates the features of the real compiler, although in a much restricted scale. This provides the learner with the opportunity to explore, modify and test some ready-made software components without causing the system to crash, i.e. in Windows programming to change the windows attributes, etc.
  3. Real Compilations: When learners have achieved sufficient experience in the virtual environment, they are ready for trying out the same procedures in the *real compiler* environment.
  4. Test/Final Project: A major feature enabled by telematic CBT is the integration of teaching, development tools and teamwork into one learning environment. In RATOL's CW this means distant independent collaboration between group members in designing and developing software using concurrent engineering.
- In the testing phase, the following types of test forms are used at present: *True-False, Matching Items, Fill-In, Single Choice from Multiple Items* and *Multiple Choice from Multiple Items* tests. In the representative sample of Figure 2 from RATOL's CW, three of these test types can be found [Manninen and Paaso 98b].

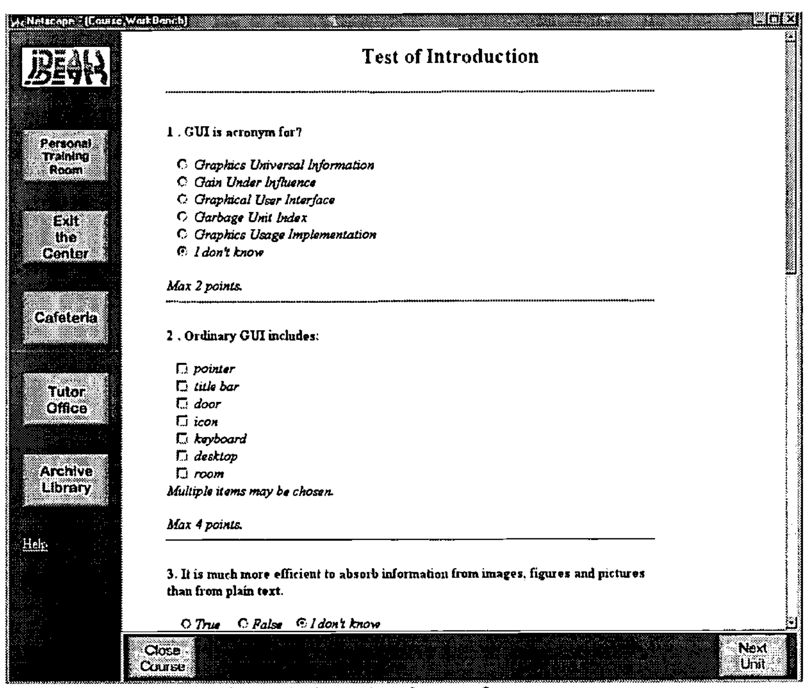

Figure 2. Sample of a test form.

4. Reuse and Multiple Use of Courseware

The multiple use of CW means the use of the same CW entities by many users. The reuse of CW means the use of CW production patterns (so-called templates) by many CW producers for the production of different CW entities. Basic building blocks, BBBs, hold a central role for the multiple use of CW (especially between different LTCs), and for the understanding of extensional and itemisation modularity of CW, and of the procedure of designing courses, as can be seen in Figure 3 (the linkage mechanisms between the modules of the CW shown) (IDEALS 1996). The basic building blocks are the components utilised from the common CW database by a teacher, in order to configure the curriculum of a course and to specify the course flow through it. A basic building block is a composition of one course node, several learning function units and their learning material objects. Their purpose is to represent a certain piece of knowledge in a CBT-based format.

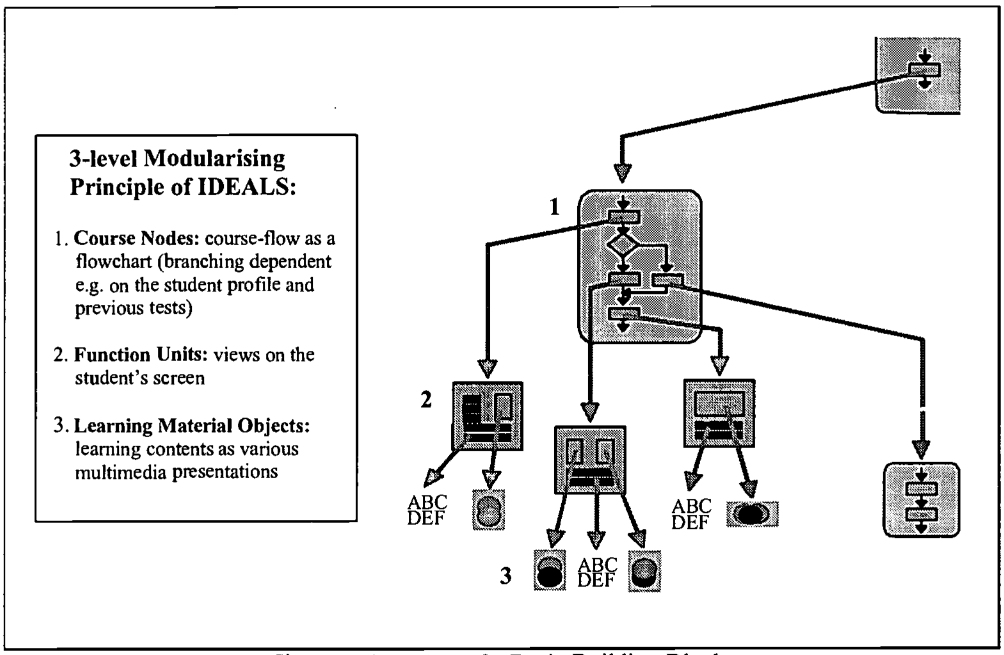

Figure 3. Structure of a Basic Building Block.

The 3-level modularising principle of the CW, with self-descriptions, virtual references and user profiling, are the strong points of the IDEALS methodology. They enable the customisable and individual course flows. Basic building blocks and templates in the common CW database, listed as catalogues, are the basis for multiple use and reuse of courseware.

5. Considerations of Authoring Efforts

The official evaluation of the IDEALS project was performed during spring 1998, and involved the evaluation of both authoring and learning phases in the IDEALS demonstration infrastructure. Based on the results relating to the authoring phase, interesting figures may be presented. In Figure 4, comparisons of the production efforts of the various versions of RATOL's CW are presented (all three phases related to the same CW, i.e. to the various incremental development phases of *Graphical User-Interface Programming, GUIPRO*), including also the case where multiple use of 40 per cent of the CW is utilised. In RATOL's 16-hour GUIPRO course, the multiple use, thus, means producing 9.5 hours of own CW and importing 6.5 hours of CW from other two IDEALS IHE pilot partners.

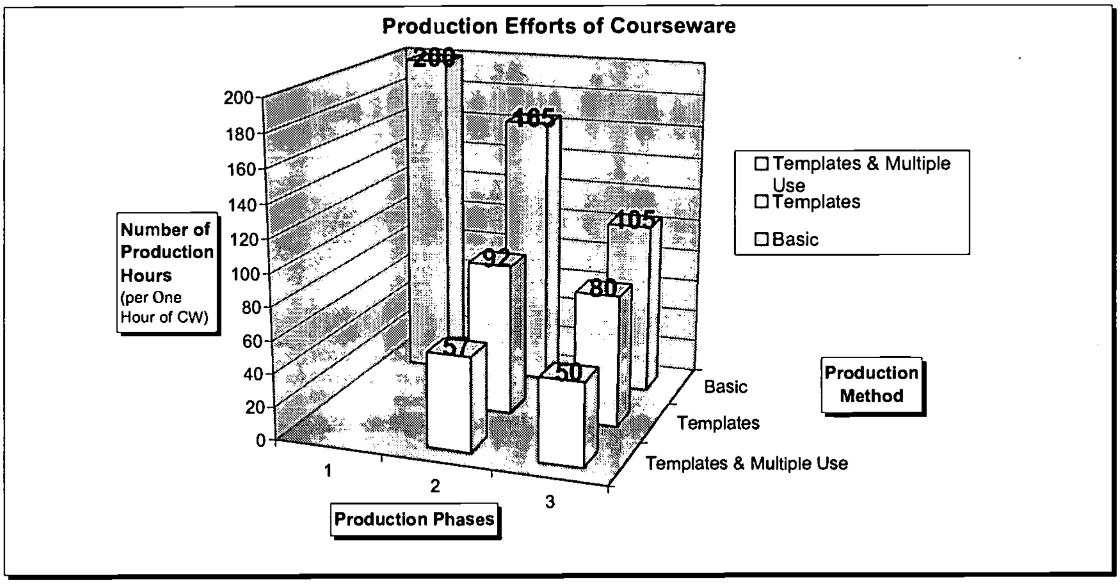

Figure 4. Production effort ratios of RATOL's CW versions.

Some conclusions relating to Figure 4 contents can be drawn:

- Utilising of templates and multiple use clearly reduces production effort. Larger multiple use percentages would, obviously, bring more, nearly linear, reduction in production efforts.
- There is a distinct learning curve in the CW production that can be seen as the development continues. The templates also improve along with the production. Both have a clear positive effect on the CW production efforts.
- The production effort ratio, even with multiple use (i.e. 40 per cent in RATOL's case) is still relatively high, i.e. 50 hours of production for one learning hour. However, it seems, based on RATOL's experiences, that, with high-quality interactive CBT CW, the required CW hours for individual learning could drop to nearly half of the required contact teaching hours for the same learning contents in traditional teaching. This would indicate that the real production effort ratio, for the same learning result, could, thus, be evaluated with this type of interactive CW to be without multiple use at about 45:1, and even better than 30:1 with multiple use of 40 per cent. However, to verify this conclusion, more extensive evaluations with larger amounts of CW and students are required. Naturally, for the first course runs, the proportional production costs are high, but after that the CBT course can be very cost-effectively repeated for large student groups [Paaso 98].

6. Situation and Learning Results

RATOL has been running the IDEALS-MTS based CBT course, *Graphical User Interface Programming,* since the beginning of November 1997. The course is targeted at B.Sc. (Eng.) and M.Sc. (Eng.) students (Engineer and Diploma Engineer students correspondingly) in the field of computer engineering. The course can also be accessed by visiting users also through the internet (Netscape, version 3.0 or later):

- Address: *http://ltc.ratol.fi*
- User-id: *guest*
- Password: *guest.*

From the first two course runs (Nov. – Dec. 1997 and March – April 1998, when also some Nokia test users were involved), there are 18 students who have completed the whole course so far (exam and the teamwork project work); this is about half of those who signed up to the course. It is to be noted that the course is optional in the course curriculum of the students. The average duration of studies among these students was approximately three weeks, resulting in an average of three hours of study per week per student. The learners were relatively motivated to study on their own during the first course run. There were no major activation procedures on the part of the lecturer or the tutors. In the second course run, the overall activity of the learners, and knowledge about their progress, could be increased by means of milestones and rewarding procedures, i.e. some didactic tests were included; they have a slight effect on the student's mark received from the course.

When considering the students who successfully passed the course, the learning results are positive, especially after considering the fact that they have been able to implement the programming project and pass the test. Even more interesting is to know what is the teaching and tutoring effort during the course runs. It is estimated that 10 hours of the highly interactive and repeatable GUIPRO courseware corresponds to about 30 contact teaching lessons (each 45 minutes, in total 22.5 hours). The start-up lesson and tutoring are estimated to require approximately seven hours in total per course run; this means a saving of approximately 15 hours in the teaching effort for this learning result.

The IDEALS methodology applied to embedded software engineering education functions extremely well, and, in fact, the methodology would seem to be excellent. However, the technical status of the IDEALS-MTS leaves plenty of development areas. At present, the instability and the deficiencies in the co-operative authoring support, in particular, are the most challenging technical problems. The technology available almost certainly will change and develop. The next version of IDEALS-MTS will also be an improved version.

7. Conclusions

The greatest value of IDEALS, for the future, is the learning network producing CW in the same modular ('standardised') way, and this is the optimum time to expand the network for new CW authors and courses. By means of co-operative authoring, remarkable cost-effectiveness improvements in the costly CBT production can be achieved. CBT course utilisation may be at least a partial solution to the huge need of increasing the graduate output in the software engineering area. Also, for the students, it can bring an increased amount of flexibility and financial savings, e.g. by decreasing unnecessary travelling, in the learning arrangements. For those who are fully employed during their studies, it might even be the only possibility.

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Innovative Tools for Interactive Learning

Oliver Kraus,Harald Neuffer, Thomas Gentner, Herbert Braisz, Martin Padeffke,Alexander Graßmann
University of Erlangen-Nuremberg
Institute for Computer-Aided Circuit Design
Prof. Dr. W. H. Glauert
Cauerstrasse 6, 91058 Erlangen
Phone: x49 9131 85286-90 Fax: x49 9131 85286-99
vhdl@lrs.e-technik.uni-erlangen.de
http://www.e-technik.uni-erlangen.de/LRS.html
GERMANY

Abstract: The activities of our institute cover various fields in the development process of integrated circuits including digital, analogue design and test.
For these separate fields we developed an interactive learning system. It is based on the capabilities of the hypertext markup language (HTML) and uses the HTTP internet protocol for distributing its contents. The aim was, to improve the quality of the student's education by offering interactive pages, that allows on the one hand access to a knowledge base and on the other hand the training on special dynamic examples. The usage of this system necessitated amplification so additional tools were developed.
The original VHDL (Very high speed integrated circuit Hardware Description Language) tutorial (www.vhdl-online.de) presented an 11 lesson course with an implemented online help system and a VHDL glossary. The additional features are a multiuser editor for moderated teleworking in distributed networks with graphical enhancements and a hardware interface for programming a field programmable gate array (FPGA) with a synthesized VHDL module to start an online test. For our students in the first and second year of electrical engineering, we developed tools for learning nodal analysis and displaying the numerical results as a Bode-plot and the symbolical results as a transfer function.

Motivation

At the moment students use our VHDL Online system to get information about the hardware description language VHDL and the design flow for developing digital circuits. It is an important task of our institute to show students the different possibilities of designing integrated circuits. The digital design methodology is only one

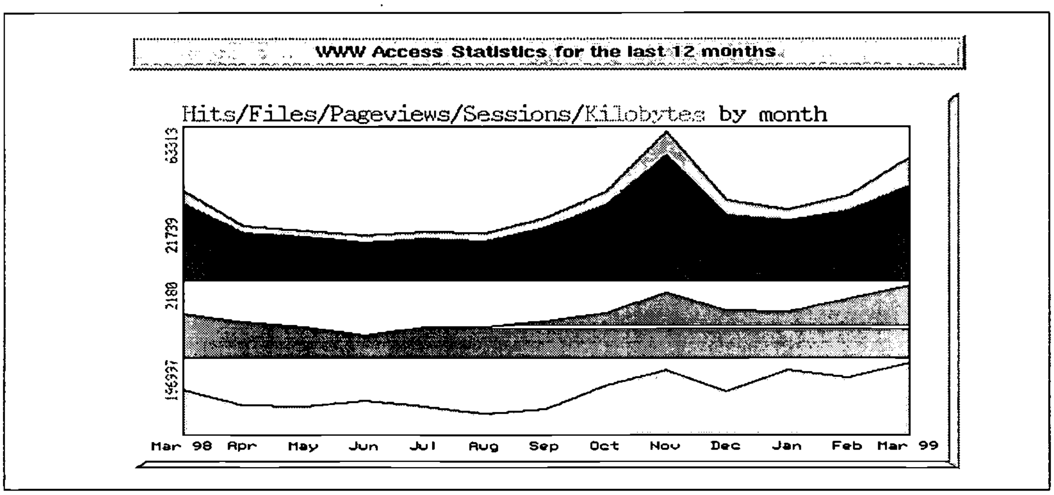

figure 1: VHDL Online Server Statistics

part of this field and in the future the need of mixed signal designs (analogue and digital) will grow. An integrated learning platform for the different fields of circuit design is a good starting basis for the students. The continuous usage of the existing learning environment confirms our strategy in teaching and is highly accepted by the students. Fig. 1 shows the statistics of our VHDL Online web server. For this reason we decided to expand the VHDL Online system with additional submodules and analogue components. The learning system is divided into several submodules.

The VHDL-Online Platform

- VHDL Tutorial: It is structured like a lecture. In one frame the students see the slides used in the normal lec-

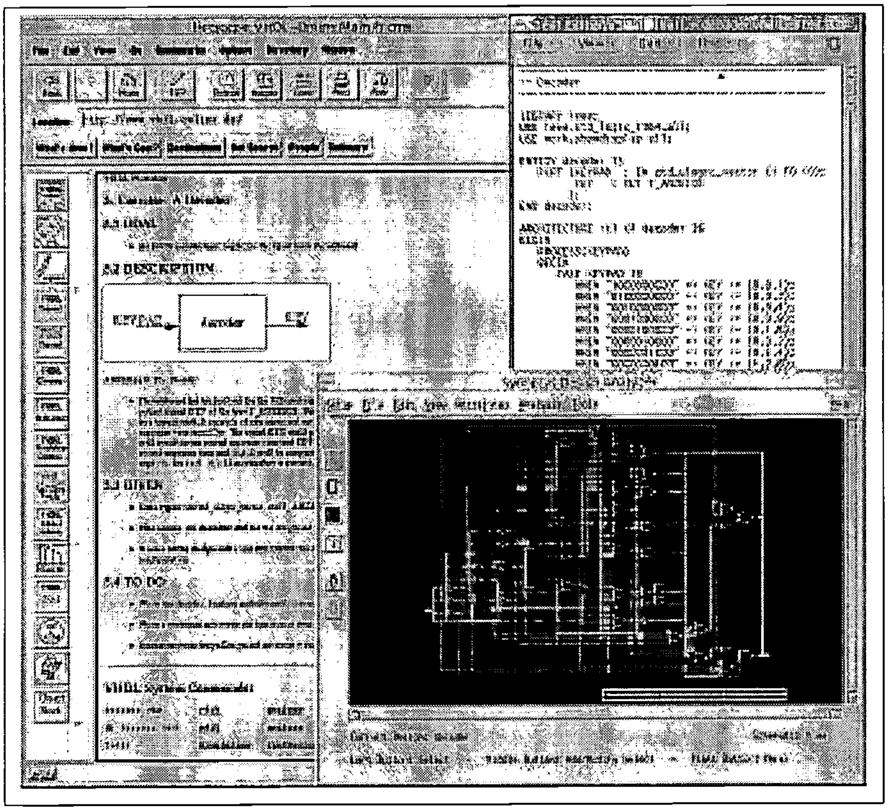

figure 2: VHDL Online Workshop

ture with the major difference that under the frame the slide will be illustrated as plain text. The contents of the text is the same as the tutor tells the students. At the end of a chapter the user can answer multiple choice questions related to the contents. If the answer is wrong, links will appear in the window, where the user gets support to the special topic.
- VHDL Reference: If a designer has got a VHDL problem (e. g. syntax of a procedure) he wants to get the information very fast instead of searching for the answer in a lot of slides. So we implemented a search function in this module.
- VHDL Workshop: In the next step the students apply their new knowledge to a practical training. They design a camera control system using VHDL. During the separate exercises it is possible to get information about a special keyword from our VHDL Reference. The students can use the search function of this module. The aim of this workshop is writing VHDL Code, simulating and synthesizing it with professional design software (Synopsys) from any internet account of the world if the user got the permission from our institute. At the end of this training it is possible to generate a netlist of the circuit. But until now the designer has not been able to transfer the circuit to real hardware. We needed an additional hard- and software module to program a FPGA. The students can verify their lesson results on real hardware. These new features are described later in this

paper.

- VHDL Chat: The first intention for this module was the support of students working outside our office. If a problem occurs they can chat with other users to exchange their experience. But we received negative feedback from the users because it is hard to describe a problem online to other persons who are not able to see the source code. The reason for this problem is the strategy of the IRC (internet relay chat). It is only possible to send one line to the other chat members. Another point is that not every user works at the same time and join the chat group to answer questions. So we decided to develop a multiuser editor where other people (e. g. the tutor) can look at a source code and make comments to special lines. This editor is described later in the paper.

Fig. 2 shows a collection of the tutorial. In the next chapter the functionality and the structure of the new integrated applications are described.

Additional Applications for VHDL Online

Modified Nodal Analysis Environment

Electrical engineering students have to analyze circuits consisting of resistors, capacitors, inductors etc. and qualify the voltage or the electric current of a network. To do this they calculate the transfer function using modified nodal analysis. For a small circuit it is easy to manage with paper and pencil. But it is also important to show the students in a short amount of time how the circuit behaves if the parameters of an electronic component are changed. It is not necessary for the students to recalculate the same circuit. For this reason our institute developed a learning system containing (Fig. 3) the following subcomponents:

The first point is a knowledge database which contains background information about the topic of analyzing

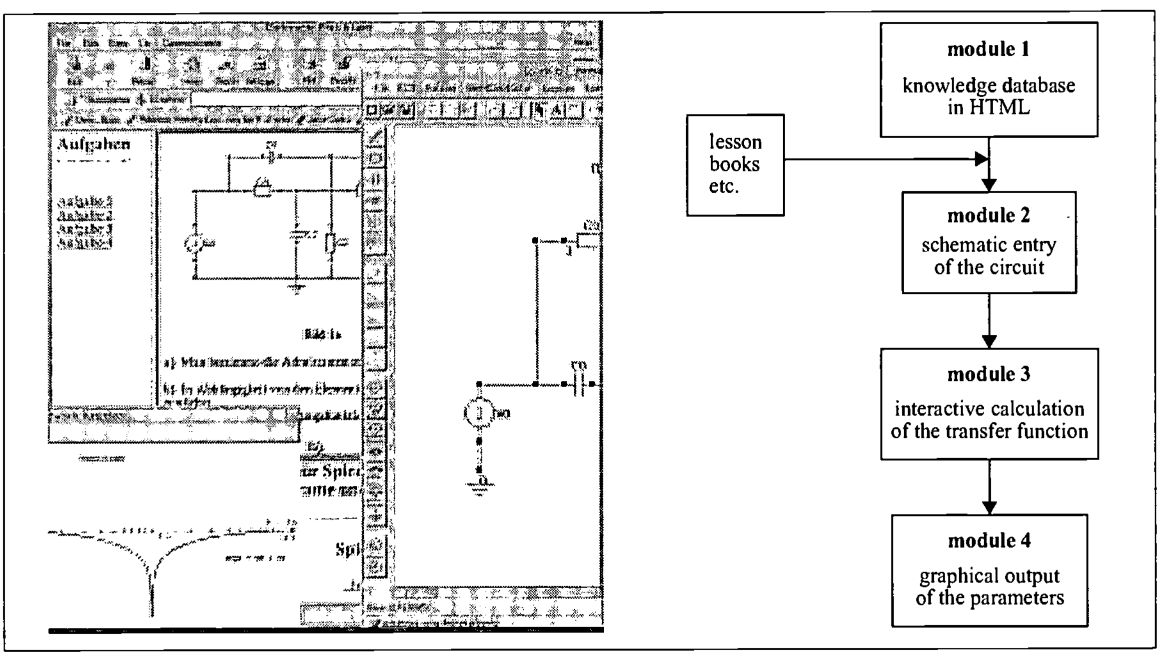

figure 3: Modified Nodal Analysis

electrical circuits. This hypertext based module uses links to get detailed information for students with little experience. In our case the modified nodal analysis will be described. Because of the modular programming structure of the whole system it is possible to exchange this current method with another one. After learning the basics of the modified nodal analysis the student solves exercises to apply this method to an example. This circuit can be drawn in the second module. It is a schematic entry tool where the user can place the electronic components (power supply, measurement instruments, resitstors etc.), assign parameters and connect the modules. This program has got all edit features of a professional graphic tool (copy, paste, rotate, move, zoom in, zoom out etc.). The tool also automatically checks whether the designed schematic is correct and shows the error location in case of a fault. All components and parameters of a spice netlist are supported by the tool. After the input of the whole circuit either the netlist can be exported to another professional simulation tool (HSPICE) or the next system module will be activated to calculate the transfer function. The program shows the elements of the matrix in an any desired way and the student must place them to the fitting position in the matrix. Thus the user does not solve the exercises just by clicking buttons but rather must he comprehend the things he learned in the lessons. To analyze the circuit it is important to get additional information like magnitude or phase of the transfer function. These graphs are generated by the fourth program module and represented in a diagram. Some additional buttons alleviate the operating of the program.

The Multiuser VHDL Editor for Moderated Teleworking

To improve the communication among the students a multiuser editor for moderated teleworking in distributed networks was implemented. The editor allows a user to invite other users to an open document. Several user authorizations can be set by the owner of the document to restrict access. These authorizations are reading, writing, drawing and copying. If there is a project with a common database, all users must have read access to the database, but only the owner of the database has write access. The common database can be a specification or a document

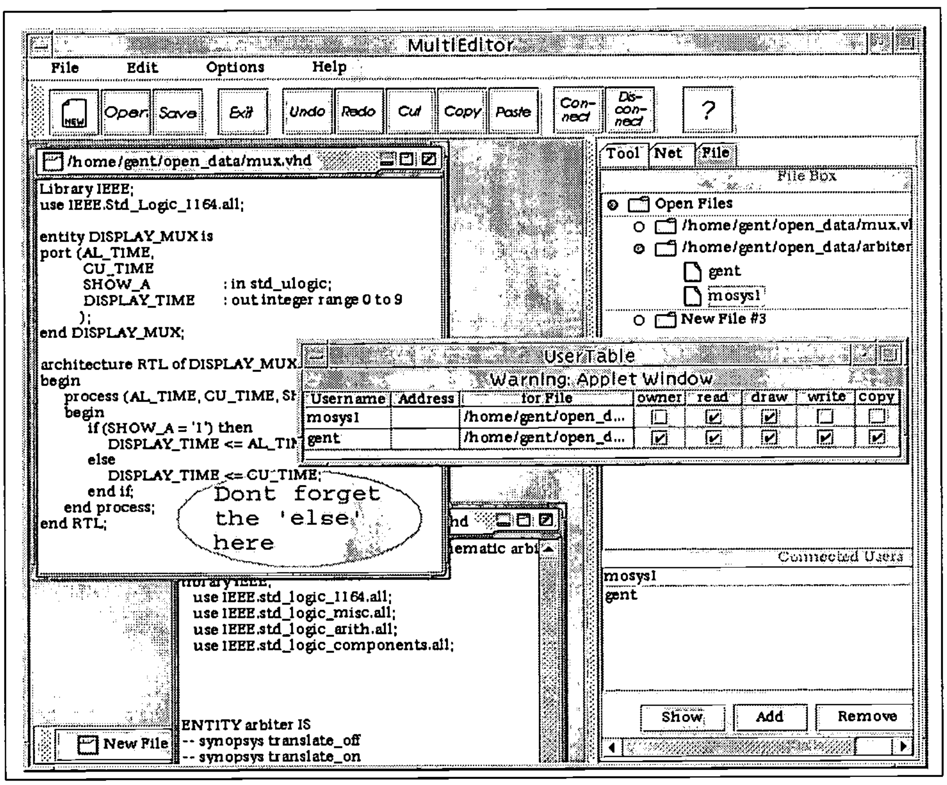

figure 4: Multi User Editor for Moderated Teleworking

that contains global variables or inter module connections. For group work or for interface descriptions only the group members and the concerned interface groups may have access to the core documents, but with different authorizations. The tutor or superuser can see all documents. So group work can be established over a network. Every user, who starts the editor will be connected to a server that is running at our institute providing information about work in progress and retrieving all the documents allowed to participate. Once connected to the server, all documents will be acknowledged, but only those documents with invited co-users are broadcasted to the mentioned users. An easy to use graphical interface was implemented to support this feature. Every user can have different rights on different documents. The document source remains on the computer of the documents owner, even if it is a distributed document. Simultaneous work of more than one user on one document is possible, a scheduling mechanism was implemented. User identification is done by getting a user name and a machine name or an internet address. A further benefit of the editor is an intuitive handling of the editor functions. The editor behaves like a normal text editor, so the user needs no time for practicing. Freely movable text or graphic can be put anywhere in the main text flow and can be anchored there. This is useful for commentating issues in the main text or for building exercises with gap text. Rudimentary graphic functions are also implemented, so readability of the text improves by laying out colored structures. Those additional features have no effect on the structural appearance of the main text flow, therefore the main text can either be saved separately or can be used directly for compiling, syntesizing, etc. Fig. 4 shows an editor screenshot of a VHDL document with some comment text (of course no one is forced to use these colors or comments).

Due to platform independence and best compatibility the editor was developed as a java application running on all platforms supporting java version 1.1. The concept of the editor allows easy updates and adaption to new requirements. It is planned to write a java applet version for using the editor within a HTML document.

The FPGA Programming Environment

Until now, VHDL Online provides a tutorial for VHDL that starts with simple VHDL examples and ends up in the synthesis of a complete design. Our idea now is to extend the tutorial so that students can test their own designs on a real hardware (Fig. 5). To extend our internet services, there are some additional requirements to the hardware. Most important, the new hardware should be available within a very short time. We started a new project to examine the use of medium size, SRAM based FPGAs as hardware resource for the designs from our tutorial. First, we changed the designflow to add some more steps that are required for FPGAs. This especially is the mapping from the result of the synthesis process to the programfile for the FPGA.

The total design flow now has the following steps:

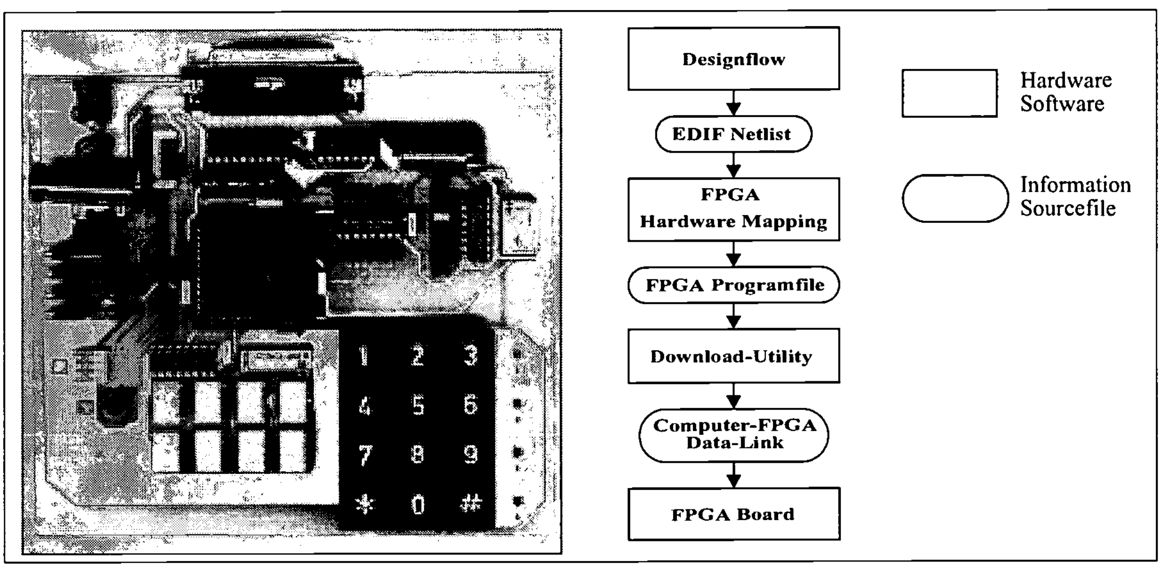

figure 5: FPGA Designflow

1. Synthesis of the VHDL sources to a complete design.
2. Design Optimization with respect to the target hardware. This means that a special synthesis library from the FPGA vendor has been used for the compilation of the design.
3. Export the design as a netlist (EDIF).
4. A special software from the FPGA vendor allows the mapping of the EDIF netlist from step 3 to the target hardware. This will generate a sourcefile that allows the programing of the FPGA (FPGA programfile).
5. Download the FPGA Programfile to the hardware.
6. Provide a suitable user interface though the internet, that enables the user to interact with the hardware.

Until now an experimental board with one small FPGA has been developed. Using this board the complete designflow has been verified. The synthesis step has been modified to generate the required EDIF netlist. We also wrote a small utility for the download of the generated FPGA Programfile. After some additional changes to our design and our hardware we successfully implemented our design on the FPGA hardware. As a result we proved that it is generally possible to provide tests with the real hardware to the internet community. Now our activities concentrate on the development of suitable hard- and software for the access from the internet to our FPGA. We decided to build a java application on the user side. This seems to be the most flexible and portable way to provide a handy interface to control the FPGA hardware.

The complete extension for our VHDL Online tutorial is divided into the following parts

1. A medium size FPGA is used as reprogrammable hardware for our designs.
2. A small digital test circuit has been build around the FPGA. This digital test circuit allows to stimulate and probe all the pins at the FPGA.
3. A small 8 Bit micro controller is responsible for the communication with the HTML server and all the other low level programming of the digital circuit and the FPGA.
4. A special server software handles the communication between the internet and the micro controller on our FPGA board.
5. The java applet on the user's internet browser can now communicate with the server software

Conclusion

To improve the learning performance of our students, we developed some enhancements to the VHDL Online tutorial. In this paper we presented tools for analogous electrical design and verification by modified nodal analysis that are fully usable via the internet. With these tools students learn about simple networks containing sources, controlled sources and passive electrical elements. The other aim was to improve the communication between the students or between student and tutor by using the multiuser editor. So learn groups or designers over the network are possible. The third application is real hardware. Students learn the difficulties of programming an existing real hardware (the FPGA) instead of simulating the behavior of their programs on the computer. This approach enables the students to find some clues for splitting their programs into FPGA fitting parts. With this VHDL tutorial the student can understand the whole VHDL design process from the specification to existing hardware. In the future we want to expand the developed learning environment to build up a system where students get information about developing integrated circuits (digital/analogue, layout, verification etc.).

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A System for the Cost-Value Evaluation of Teleteaching Systems and Its Application

Thomas Walter, Bernhard Plattner
Computer Engineering and Networks Laboratory, Swiss Federal Institute of Technology Zurich
Gloriastr. 35, ETH Zentrum, CH-8092 Zürich

Martin Hildebrand, Stefan Hinni,
Industrial Management and Manufacturing Engineering, Swiss Federal Institute of Technology Zurich
CH-8092 Zürich

Abstract: We present a model and system for the cost-value evaluation of teleteaching systems. Basically, the model considers the total costs of a teleteaching systems and, additionally, different levels of benefits. The benefits are classified as either objective, e.g., transmitted audio and video quality, or subjective, e.g., personal feelings. Two cost-value ratios are computed by, first, combining the total costs and the objective benefits and, second, by combining this result with the subjective benefits value. The smaller the cost-value ratio the better is the system. The model is implemented by a number of EXCEL®-worksheets.

1 Introduction

The advanced developments of communication systems, e.g., high-speed networks with guaranteed quality-of-service as in ATM (Asynchronous Transfer Mode) networks (Händel & Huber 91; de Prycker 95), and audio- and video technology, e.g., video compression schemes such as JPEG (Joint Photographic Expert Group) (ISO 92), have yielded very powerful digital and multimedia-oriented information and communication technologies (ICT) (Fluckiger 95; Steinmetz & Nahrstedt 95). These new technologies are influencing most areas of our daily life including education (Dutta-Roy 98). In distance education, these technologies open the door to very efficient education systems (see, e.g., the publications at ED-MEDIA). A matter of fact, however, is that these systems are not for free.

In this paper we discuss a model and system for the cost-value evaluation of teleteaching systems. We define teleteaching as synchronous and interactive distance education: *synchronous* means that teachers and students meet at the same time but not necessarily at the same place. *Interactive* means that all participants can freely interact to post questions or give comments. In our context, teleteaching takes place between geographically distributed classrooms. As a consequence audio, video and data streams have to be transmitted between classrooms. In support of this, classrooms are equipped with devices such as cameras, microphones, beamers, PCs, coder-decoder devices and communication devices, for recording, transmitting and displaying multimedia data. The devices mentioned have to be purchased, installed, maintained, operated etc. Altogether, the costs of a teleteaching system are serious.

Our work on a model and system for the cost-value evaluation of teleteaching systems was motivated by the fact that since 2 ½ years we run the teleteaching system *Telepoly* (Walter & Hänni 98), but its accurate costs were unknown. We developed a system for the calculation of the overall costs for teleteaching systems. The costs can be determined in total, per lecturing hour and per participating student. Furthermore, different teleteaching systems can be compared and ranked in terms of their respective cost-value ratios. Basically, for comparing and ranking systems the model considers costs per hour and, in addition, different levels of benefits. The benefits are classified as either objective, e.g., audio and video quality, or subjective, e.g., personal feelings.

The system consists of a number of EXCEL®-worksheets. The worksheets are given as forms to be filled in. The calculation of different teleteaching systems is possible even for different usage scenarios (in terms of number of classrooms, hours of use etc.).

The paper is structured as follows: In Section 2 we give a brief description of a typical teleteaching scenario. The different types of costs to be considered are discussed in Section 3. Section 4 introduces our system for the evaluation of teleteaching systems. First, we explain the use of the system to evaluate a single system. Second, we show with a real life example how different systems can be compared. In Section 5, we conclude with a summary and an outlook.

2 Teleteaching Scenario

As stated in the introduction, teleteaching is understood as an interactive and synchronous distance education scenario. More specifically, we consider a scenario where teleteaching is done between classrooms only. Teachers and students are located in two or more classrooms. The classroom where the teacher is located is referred to as the *local classroom* all other classrooms are *remote*. Classrooms may be at universities but may also be at private organizations and business companies (Fig. 1).

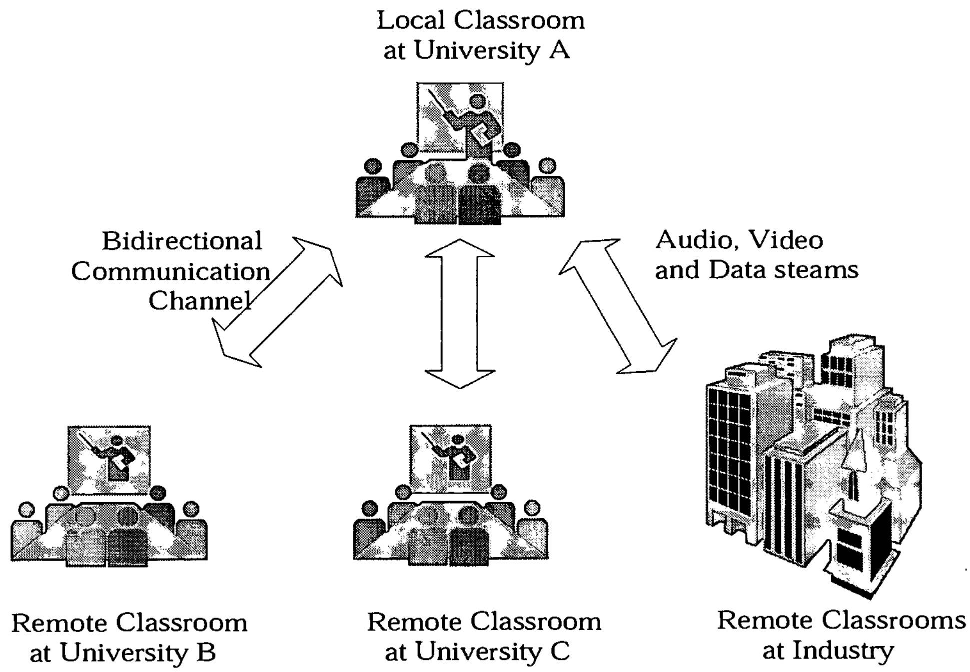

Figure 1: Multipoint Teleteaching Scenario

For the described teleteaching scenario, the following multimedia streams are exchanged between classrooms:

- An audio and a video stream of the teacher which is permanently transmitted to all connected sites.
- An audio and a video of the students in the local classroom. Note that the audio of teacher and students are mixed into one audio stream which is sent to all remote sites.
- A video stream of a visualizer (or document camera) which can be used by the teacher in order to present material which is not available electronically, such as concrete objects, statistics from a present-day journal etc.
- A data stream is transmitted from the local classroom to remote classrooms. This data stream is for teaching aids that are electronically available. A screen or application sharing software is used for making the teaching aids visible at all sites.
- From remote sites, an audio and a video stream are transmitted to all other sites.

We require that at least one audio and one video stream and, additionally, a data stream for teaching aids can be exchanged between classrooms. Alternatively, more than one video stream can be sent which, however, depends on the capabilities of the system used.

3 Types of Costs

In a first step, we made a distinction between types of costs that are independent of the chosen teleteaching system, e.g., training of teachers, preparation of electronic teaching aids, general infrastructure in classrooms, and types of costs directly related to teleteaching. The latter are covered by our model and are discussed below. We have adapted an approach developed in (Gartner 98) (for the total costs of ownership of a PC).

Equipment:

- Audio: microphones for teacher and students, speaker boxes, audio mixer.
- Video: cameras for teacher and students, automatic tracking system for teacher camera, visualizer, LCD-beamers for displaying video (e.g., remote classrooms) and computer data (e.g., teaching aids).
- Communication infrastructure: coder-decoder (CODEC) devices for converting analog signals to digital ones and coding for transmission over a communications network, communication equipment such as switches, network interfaces for switches.
- Hardware and software: PC or workstation for presentation of electronic teaching aids, multimedia equipment for PCs or workstations, network interface cards for PCs or workstations, application or screen sharing software for the presentation of teachings aids locally and remotely, presentation software for the preparation of electronic teaching aids.

Manpower:

- Operator: maintenance of the teleteaching system, preparation of teleteaching sessions, installation and deinstallation of the teleteaching system.
- Teleteaching assistance: support for teachers and learners while a teleteaching session is running.

Operation:

- Communication interface: basic charge or connection fee for access to a communications network.
- Communication links: time and/or volume based transmission costs.

The costs for equipment and manpower have to be calculated for every classroom. This also applies to the costs for communication interfaces. The costs for communication links depend on the number of sites interconnected, the number of connections that are used and the kind of multipoint communication support provided by the network. If, for instance, all multimedia streams are sent from one site to all other sites separately, then one has to set-up one connection per site. If multipoint connections are supported by the network, then duplication and redirection of media streams is done in the network itself which saves communication costs.

It turned out that the investments in audio and video equipment are the driving cost factors. They vary and depend on whether consumer or high-end professional audio and video equipment is used (some figures are given in Section 4.3). These costs are independent of the underlying communication network being used. If a turnkey teleteaching system is purchased the overall costs are fixed.

4 Cost-Value Evaluation System

The system is implemented by a number of Excel®-worksheets. Each worksheet contains mandatory input cells. All the necessary computations described below are programmed into the worksheets which is hidden from the user. The approach and the environment chosen provide the flexibility that the system is adaptable and extensible.

4.1 Total Costs, Objective and Subjective Benefits

In a first worksheet the costs of a teleteaching system according to the types of costs presented in the previous section are collected. From this worksheet the total costs of a system are computed. Furthermore, various other reference figures are calculated such as costs per hour of operation and costs per student. We use the costs per hour figure in our cost-value evaluation. This worksheet has to be filled in for every teleteaching system.

In a second worksheet a value for the *objective benefits* (of a teleteaching system) is computed. Essentially, we identified a number of criteria (referred to as Service Quality in Fig. 2) which allow us to determine the overall performance and quality of a teleteaching system. The criteria include audio and video quality, number of audio and video streams that can be transmitted simultaneously, administrative and operational overhead to set-up and run a teleteaching session etc. These criteria are put into a check list. For each item in the list, a number of options are pre-defined. An option gives a possible instance of the criterion. Every option has a value defined (1 - 5). The value reflects the option's importance, i.e., counts for the benefit that can be gained if this option is supported.

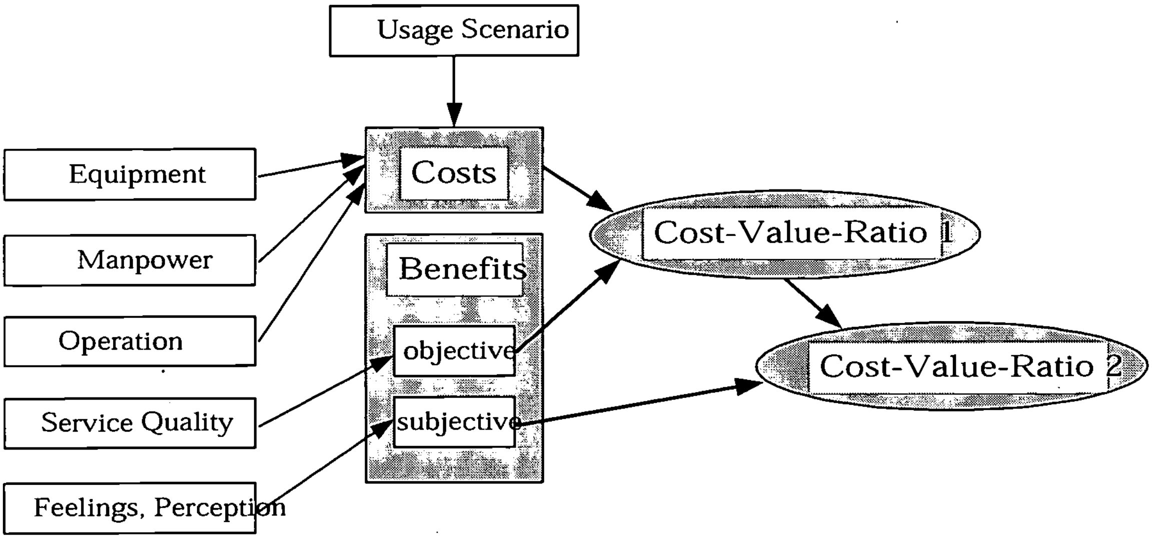

Figure 2: Cost-Value-Ratio Evaluation Process

With each item a second value, called weight, is given (in the range of 1 - 5). The weight represents the importance of the item with respect to all others. The item's value, i.e., the value of the option chosen, is multiplied with the item's weight giving a *relative weight* for this item which defines the relative importance of the item as seen by the user. If the checklist has been completed, a single value, called *objective benefits*, is computed by dividing the sum of all relative weights by the sum of all weights. This worksheet has to be filled in once and will remain fixed for all systems to be evaluated.

Similarly, a third worksheet counts for subjective preferences of users (termed Feelings and Perception in Fig. 2), i.e., how they have perceived a teleteaching session using a specific system. The form of the worksheet and how it is processed is the same as described before. At the end of the procedure, a single value, called *subjective benefits*, is computed. The evaluation of this worksheet changes for different systems.

4.2 Evaluation Process

The evaluation process is done in three steps (Fig. 2). In a first step, all worksheets have to be completed. In addition to the cost summary, a user has to provide figures on the expected usage of the teleteaching system: number of remote classrooms, number of lectures per week, duration of each lecture. From this information the costs per hour are computed. For an application with real world data for two different teleteaching systems refer to Tab. 1.

In the second step, the costs per hour and the value computed from the worksheet for the objective benefits are condensed into a single *cost-value ratio 1*. This is done as follows: The costs per hour value is divided by the objective benefits value. The lower the cost-value ratio the better is the system.

If the computed cost-value ratio 1 is almost the same for the teleteaching systems evaluated, then the better system can be determined by applying the subjective benefits value to the cost-value ratio 1, thus giving the *cost-value ratio 2*.

4.3 Application of the System

As an application of the cost-value evaluation system we compared our ATM-based teleteaching system Telepoly and an ISDN-based (Integrated Services Digital Network) teleteaching system. Telepoly supports the transmission of up to three bidirectional high-quality video and audio streams. We use three video and one audio stream for which we make an ATM-reservation of 38 MBit/s. This means almost 12 MBit/s for the transmission of a Motion JPEG compressed video stream and 2 MBit/s for a CD-quality stereo audio stream. Data transmission for teaching aides uses the Internet and is not included in the following cost calculation.

For the ISDN-based videoconferencing system we assume that three basic rate interfaces are used which gives a total transmission bandwidth of 384 KBit/s. The system supports the bidirectional transmission of one video and one audio stream and, additionally, the transmission of electronic teaching aids.

The cost-value evaluation of the systems is based on the assumption that specific audio and video equipment is purchased. The costs for audio and video equipment are assumed to be the same for both systems. Tab. 1 summarizes the cost evaluation for the systems in Swiss Francs (1 sFr = 0.62 Euro or 1 sFr = 0.74 US$ at time of writing) on the basis of an amortization period for the equipment of three years, 40 students in one remote classroom, six hours of operation per day which gives a total of 840 hours per year (assuming 28 weeks of lectures per year).

The cost evaluation of the systems shows that the ISDN system has an advantage over the Telepoly system. However, the actual transmissions costs in MBit/s are less for ATM (sFr. 37.63) than ISDN (sFr. 90.00) although the reserved bandwidth is much (100 times) higher and three video streams are transmitted simultaneously. Note that transmission of one video stream slightly reduces the transmission costs only.

The second and third step in the cost-value evaluation of the teleteaching systems consists in applying the objective and subjective benefits to determine the cost-value ratios 1 and 2, respectively (Tab. 2).

The ISDN system has a better cost-value ratio 1. Taking into account the subjective benefits then the ATM system performs slightly better. This is because the audio and video quality of the system outperforms the quality that can be achieved with an ISDN system. Note also that Telepoly supports transmission of up to three video and audio streams and supports multipoint sessions which has not been further considered in the above discussion.

5 Conclusions

We have presented a model and system for the cost-value evaluation of teleteaching systems. The model was designed with two main objectives in mind. First, the model should be useful in order to determine the costs of a teleteaching system. For this we defined a comprehensive list of types of costs. Second, the model should be used also for comparing and ranking teleteaching systems. This is done by computing two cost-value ratios. For this, objective and subjective benefits of teleteaching systems are ascertained by having check lists to be filled in. If this has been done, then, the objective benefits are considered and only if the resulting cost-value ratio 1 is almost the same then the subjective benefits value is used.

The system has been implemented as a number of interrelated Excel®-worksheets. The different steps in calculating total costs, objective and subjective benefits and cost-value ratios are done automatically. The system is flexible in the sense that changes can be applied whenener necessary.

	ATM (38 MBit/s) [sFr.]		ISDN (384 Kbit/s) [sFr]	
	Total	**per hour**	**Total**	**per hour**
Equipment:				
Audio	143'507.--		143'507.--	
Video	350'905.--		350'905.--	
PC	8'000.--		8'000.--	
Control (Touch panel etc.)	120'777.--		120'777.--	
Transmission (CODEC, switch etc.	61'988.--		4'700.--	
Total costs equipment/year	283'392.33	271.90	209'296.33	249.16
Transmission:				
Basic charge	70'200.--		1'917.--	
per hour		83.57		2.28
Bandwidth		37.62		90.00
Manpower:				
In- & Deinstallation/Guidance (h à sFr. 100,--)	x 1.5	150.--	X 1.33	133.33
Total costs per hour		543.09		477.77
Total costs per student/hour		13.58		11.86

Table 1: Costs Figures for Telepoly- and ISDN-System

	ATM	**ISDN system**
Costs per hour	sFr. 543.09	sFr. 474.77
Objective benefits	4.24	4.08
Cost-value ratio 1	**128.09**	**116.37**
Subjective benefits	4.51	4.05
Cost-value ratio 2	**28.40**	**28.73**

(Assumptions: 840 hours/year, 1 remote classroom)

Table 2: Cost-Value-Ratio 1 and 2 for Telepoly and ISDN system

We have used the system for an a posteriori evaluation of our own teleteaching system Telepoly. We have done a cost analysis to find out the actual costs of a teleteaching session. Furthermore, we have performed an evaluation of our system against an ISDN-based system. Although total transmission and operation costs are higher for Telepoly than for the other, the cost-value ratios of Telepoly are almost equally well. The cost-value evaluation system is still under development. In particular, the information on the objective and subjective benefits needs to be further justified.

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Applying the Object Oriented Design in Combination with the Hypertext Mode for Prototyping in Different Topics

Christina Metaxaki- Kossionides, Stavroula Lialiou and Georgios Kouroupetroglou
Department of Informatics,
University of Athens,
Panepistimiopolis, Ilisia,
GR-15784 Athens, Greece
(metaxaki, stud0518, koupe)@di.uoa.gr

Abstract: In this paper the object oriented design is combined with the hypertext mode to achieve an efficient system's structure which help the learner to navigate freely and stay in a certain context. Within this novel framework, tools and approaches can be shared or used while designing educational systems for different topics or didactic methodologies. Furthermore, the parallel design of educational systems for two different topics, history and physics, using the combined formation is presented. We have investigated the dependencies of objects and the sharing of tools used during the development of the two prototypes. Both systems are engaging, expandable and transferrable.

Introduction

The user interface design and the content's exploration are key issues, especially in educational applications. The interface is required to engage the user and offer aesthetic information presentation. The communication and interaction for the content's exploration should lead to knowledge aquisition. Adaptation to learner's selections and flexibility for different scenarios' execution are highly recommended. The disorientation that is created by the adaptation and the flexibility, should be eliminated (Shneiderman 1992), (Metaxaki et al. 1991a), (Kouroupetroglou et al. 1995).

The design, implementation and content development in multimedia systems are quite expensive. Thus, resuability of the content and/or a sucescfull former design approach is a requirement. In some applications, the re-use of a piece of content in the same or different format realizes educational aspects or didactic procedures (Metaxaki et al. 1991b), (Metaxaki et al. 1994).

In this paper, we present a novel approach to meet the mentioned needs. The structure of the proposed system is a combination of the hypertext mode and the object oriented architecture, implemented by embedded objects or components. There can be a design approach including objects descriptions which can be enriched by operation functions to face various needs. These functions can be interchanged by learner's selection to help him navigate freely without losing the context of the exploration (Rumbaugh et al. 1991), (Fayad and Schmidt 1997), (Aedo et al. 1996), (Wisnudel 1994).

Two applications using the same methodology have been desogned and developed to explore the dependence and the transferability of the object's description and presentation. The sharing of tools was investigated, too.

Aspects of the Combined Methodology

The extensively used hypertext mode has two main problems: the increasing number of connections over a topic and the disorientation these connections can create after some navigation steps. A novel method is required which could add connections of data and tools to eliminate this disorientation. The object oriented architecture can be used for this purpose.

Our decision was to design, implement and investigate according to the Component Display Theory (CDT) defined by Merill as: "The CDT is comprised of three parts: a two-dimensional performance-content classification system, a taxonomy of presentation forms, and a set of prescriptions relating the classification system to the presentation forms. CDT assumes that all instructional presentations are comprised of a series of discrete displays or presentation forms. Any presentation can be described as a sequence of such presentation forms, together with the interelationships between these forms" (Merill 1984), (Merill 1983).

A main notion of the embedded component (EC) structure is the independence between the objects used for presentation and the ones used for the information presented. This allows the appearance of the same information in multiple locations and in different forms. Moreover, new objects can be created in succession, the previously constructed ones can be re-used and the new ones are easily integrated in the system. An object can be plain or enriched, active (sound, video, motion) or inactive (plain text). Objects can be concrete or embedded on other objects. The objects can be interconnected through links pre-existing or created by user queries. Using the embedded objects we can succeed in the integration of information, the integration of media, the re-use of information and the flexibility of the presentation of information on a display (Spitzer 1997), (Baecker et al. 1995), (De Diana et al. 1994).

The Design Approach

System's Objects and Modules

The Objects

The objects are differentiated as *data objects* (dao) and display objects (dio). The *dao* are enfolding the data, the implementation of the possible links, and the execution of queries. They are of two different types, the *main* and *the instance data objects (mdao, idao)*. The *mdao* include the required information for the definition of an entity. The content of the *dao* can be a maximum or minimum depending on the topic or the didactic procedure i.e. *mdao* for the lesson on physics include the maximum content for a physical phaenomenon or a minimum to be further combined. The ones for the lesson of history are usually of a minimum content and are combined to form a historical event. Each *mdao* is connected with one or more *idao*, containing data and format information.

The *dio* include all parameters needed for the formation of a presentation on the display. Their parameters depend mainly on the type and format of information. They contain, too, the interactivity functions. The execution of *dio* performs the *dao*'s presentation. We emphasize that the *dio* do not define the interconnections of this presentation.

We can say that the system communication is organized in two layers. The presentation layer and the data layer. The user interacts with the presentation layer. At this layer the learner's requests and actions are interpreted and transferred to the data layer. The data layer processes the interpreted requests and a presentation appears on the display.

The Modules

We can assume that the system consists of three types of modules (Fig. 1): the Objects Module (OM), the Navigation Tools Module (NTM) and the Main Pages Module (MPM). The Objects Module contains all the objects of the system we have already described. The NTM supports the selected navigation and contains all the constantly presented elements of the display (chapters, menus etc). The MPM includes the main thematic pages of the system. These pages are the starting point for the user's exploration. They form the base for the orientation and the structuring of user's reactions and the selected objects' presentation. The pages are intercommunicating.

Both the hypertext navigation mode and the embedded object architecture co-exist in the system. The hypertext based interaction is realised in the communication between the MPM and the NTM. The objects-based interaction is realised in: (a) the communication inter-MPM, between the MPM and the OM, (b) the intercommunication of the OM.

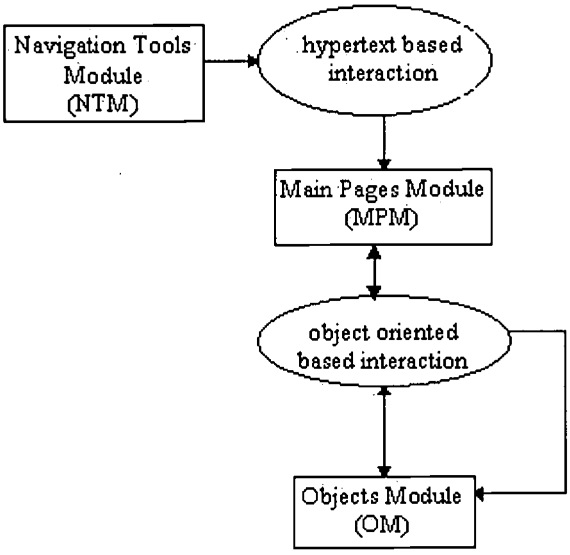

Figure 1: The General Design Approach

The combination of the two modes and the creation of the modules content create a frame in which various didactic procedures can be realized. The system can be adapted to the learner's needs.

Structure of the System and Applications

In order to design, structure the system and investigate the methodology we have decided to prototype in parallel on two different topics with which we had already a good familiarity (physics, history). The two topics concerning their implementation were differentiated by the type of exploration depth-width and the format of the presented information. The type of the exercises, too, were different. The base of reference was to keep elements of an electronic hypermedia book (Laurel et al. 1990), (Thuering et al. 1995), (Mullin 1990), (Metaxaki et al. 1995).

Both systems include links (for direct or nonsequential access), embedded objects, navigation bars or menus, wedges (areas offering additional information by direct access), floating windows (wedges enriched by functional characteristics), indexes and recapitulatory nodes.

In Fig.2 we present the structure of the applications. The structure is common although the outlook is different. There exist on the display the constantly shown fields and the changing ones. The constantly shown ones (menu, navigation bar, chapters etc) assist the user's orientation in a context. The user selects (links, buttons) a sub-topic, moves directly to it (main pages) and starts the exploration.

The exploration can be continued in depth or width by queries, indexes etc. The one in depth will occur by selection (links, hotspot areas etc) and the presentation of embedded objects in wedges or floating windows format. The other in width will occur by direct returns to the main pages and/or the extensive formation of interconnecting embedded objects. Windows or wedges can be opened concurrently or in sequence, overlayed or not.

Discussion and Results

The design of the two systems in parallel was proved quite succesful and spared development time. The topic of the nuclear physics needed a large amount of simulated and animated information. The topic of history was about the Emperor Carolus Magnus and needed texts and the reproduction of images. Our great difficulty was the presentation of the objects, which was developed in a parametric way so that we could share programming tools. The definition of the changing areas and the floating windows outlook as well as the connections of texts and pictures was scheduled in our system for the pictorial communication research (Metaxaki et al. 1996), (Kouroupetroglou et al. 1994). We can conclude that the information content was developed independently but for the presentation development we have used the same parametric tools. The object definitions were quite short for the history in comparison with the ones for physics but they contained more data. The inteconnections between objects were less extensive for nuclear physics. This means that the objects were more concrete. The in depth exploration of the topic was achievable by the system as well as the in width exploration for history.

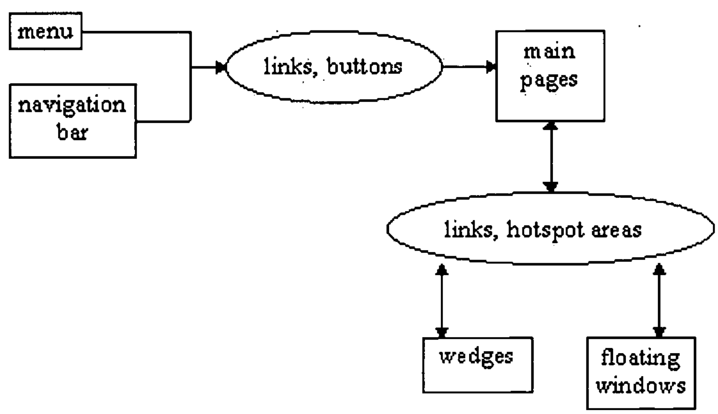

Figure 2: The common structure and communication for both prototypes

We work further using the same methodology and transferring tools and experience to the topic of human sciences.

Conclusions

The use of object oriented design in connection with the hypermedia mode to design educational systems is a quite successful approach. It helps the learner to navigate through the system feeling free but staying in the context. The learner can choose his own way to explore the system. The teacher or tutor can realize different scenarios taken advantage of the system's flexibility. The system can be explored in depth or width or both sequentially depending on the learning process.

The implementation of the approach needs expert programmers but the system is expandable and includes a large amount of transferability. When the system's content is existing in an intra-net server this type of design is much more powerful.

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Distance Learning in Multimedia Networks Project – Experiences and Results

Seppo Pohjolainen & Heli Ruokamo
Tampere University of Technology/Digital Media Institute
Department of Mathematics/Hypermedia Laboratory
P.O.Box 692, FIN-33101 TAMPERE, Finland
Tel. + 358 3 365 2111, Fax + 358 3 365 3549
E-mail: Seppo.Pohjolainen@cc.tut.fi, Heli.Ruokamo@cc.tut.fi

Abstract: This paper discusses a goal-oriented project called Distance Learning in Multimedia Networks (ETÄKAMU) <URL: http://matwww.ee.tut.fi/kamu/> that is a part of the Finnish Multimedia Programme (FMP). The project started on the 1st of February 1996 and lasted until January 1999. The project combined the efforts of Finnish telecommunication companies, content providers, publishing houses, hardware companies and educational institutions in the field of distance learning. One of the main goals of the project was to develop and pilot pedagogically appropriate and technically functional open learning environments. In this paper we present the main results of the project.

Introduction

The Distance Learning in Multimedia Networks Project <URL: http://matwww.ee.tut.fi/kamu/> combined Finnish technical and pedagogical research centres and institutions in the field of distance learning, hardware and software producers, publishing houses and telecommunication companies in an extensive joint project. In 1998 the budget of the project was approximately 4,7 million Finnish marks (900 000 USD). The project was funded jointly by the Technology Development Centre of Finland (TEKES) and by 32 Finnish enterprises. It was coordinated by the Hypermedia Laboratory of the Digital Media Institute at Tampere University of Technology. (Pohjolainen & Ruokamo 1998.)

The aim of the Distance Learning in Multimedia Networks Project was to research and develop pedagogically appropriate and technically functional open learning environments for distance learning based on computer networks. The design of the learning environments is based on the rapid development of information technology, especially on broadband computer networks and hypermedia-based learning materials. The learning environments were studied and developed from telecommunications (hardware), hypermedia material (courseware) (Nykänen & Ala-Rantala 1998, Pohjolainen, Ala-Rantala, Nykänen & Ruokamo 1999) and pedagogical points of view (Ruokamo & Pohjolainen 1998).

Distance learning using multimedia is exploited by schools, educational institutions, and enterprises for all ages ranging from children to adult learners. Various pilot projects and teaching experiments was set up in ten pilot areas to gain feedback from the methods and solutions developed. The purpose of the teaching experiments was to test both the technical and pedagogical functionality of the distance learning solutions developed.

Collaborating Partners

The Distance Learning in Multimedia Networks Project was divided between research and enterprise partners. The universities were the research partners in the project. The Digital Media Institute (DMI) operating at Tampere University of Technology was the project coordinator and the other units functioned as subcontractors to it. Research partners were

- Tampere University of Technology / DMI / Hypermedia Laboratory,
- Helsinki University of Technology / Centre for Educational Technologies,
- University of Tampere / Hypermedia Laboratory,
- University of Tampere / Institute for Extension Studies,

- University of Jyväskylä / Information Technology Research Institute,
- University of Helsinki / Lahti Research and Training Centre.

The project's enterprise partners were divided into steering enterprises and follow-up enterprises. Steering enterprises were as follows: City of Jyväskylä, City of Tampere, Data Network Institute, Edita Group, Finnet/HPY Ltd., Helsinki Institute of Physics, Helsinki Media Company Ltd., Jyväskylä Science Park Ltd., Lifelong Learning Institute Dipoli/Helsinki University of Technology, Nokia Mobile Phones, Otava Ltd., Sonera Ltd., Sun Microsystems Ltd., Tampere Technology Centre Hermia, WSOY Ltd., and Xenex Ltd. ETÄKAMU's follow-up enterprises were AAC-Institute, Centre for Technical Training AEL, City of Nokia, CSC - The Center for Scientific Computing, Finnet/TPO Ltd., Finnish Association of Adult Education Centres KTOL, KVS-Institute, Mänttä Regional Education Center, Promanet Ltd., Promentor Solutions Ltd., STAKES (National Research and Development Centre for Welfare and Health), Teleste Educational Ltd., The Folk High School for Finns in Sweden, The Subregion of South-East Central Finland, Valmet Ltd., and WM-data Kasanen.

The Project's Organization and Research Activities

The organization of the Distance Learning in Multimedia Networks Project was divided into a steering committee, a supporting group, research groups and pilot areas. The *steering committee* decided on general plans and coordinated the activities between industry and academia. *The supporting group* was composed of all the researchers of the project and staff from research units that were responsible for the project. The research activities of the ETÄKAMU project were divided into two parts, i.e. into research conducted by research groups whose objective was to produce knowledge in support of project activities, function as a support for pilots, organize necessary training, and analyze experiences gained from the pilots. The three *research groups* were concentrating on: development of a prototype of an open learning environment, development of criteria for technical functionality and structure for hypermedia-based materials, and development of methods for distance learning and pedagogical evaluation criteria for open learning environments.

In addition to the three research groups several *pilots* were set up in various areas via which distance learning solutions in multimedia networks were carried out in practice and feedback on the performance of technical and pedagogical solutions was obtained. The participants in the *pilots* were project researchers and staff of enterprises, and teachers and students of educational institutions. The pilots were divided into the following pilot areas: 1. Broadband networks and technical experiments, 2. Natural sciences, 3. Language learning, 4. Education, 5. Communication, 6. In-house education for enterprises, 7. History and civics, 8. New school learning materials (KUOMA), 9. Finnish children abroad, and 10. Web university (WU) (see Rinta-Filppula 1998).

During the three years project expanded in many ways. Participants included pupils, university students, adult learners and employees of enterprises - the idea of lifelong learning was adopted. Distance learning was seen not only as a matter for educational institutions but also enterprises were interested in utilizing it. Distance Learning in Multimedia Networks Project grew into a significant co-operative effort between research institutes, educational institutions and enterprises.

During the last year of the ETÄKAMU project the main emphasis was on analyzing and reporting the final results of the project. The project's development and research work during the third year was divided as follows:

- Collecting the data from a number of teaching experiments that were arranged during spring and autumn 1998.
- Analyzing of the results were done using pedagogical and technical evaluation criteria.
- Development of the prototype of an open learning environment has continued until the end of January 1999.
- Project's final results have been analyzed and will be published as a book (Ruokamo & Pohjolainen 1999) and on the web.
- In January 1999 the project arranged a closing seminar "Pedagogical Methods and Technical Solutions for Distance Learning IV".

Pedagogical Research Problems

The ETÄKAMU project applied seven important qualities of meaningful learning - based on the list presented by Jonassen (1995) - as guidelines in the design, implementation, and evaluation of the open learning environments (see Pohjolainen & Ruokamo 1998; Ruokamo & Pohjolainen 1998, 1999). On the basis of the qualities of meaningful learning, the following research problems for the pedagogical evaluation of learning environments were set:

1. Does the learning environment support learner-centered learning?

1.1. Does the learning environment support learners' active construction of new knowledge on the basis of prior knowledge in interaction with the surrounding reality (Constructivity)?

1.2. Is the learner's role active and are the learners responsible actors in the learning environment (Activity)?

1.3. Can learners work together and construct new knowledge with one another while utilizing each other's skills (Collaborativity)?

1.4. Has the learning environment taken due heed of learners' goals and does it support the achievement of their knowledge objectives (Intentionality)?

1.5. Are the learning tasks located in meaningful, real-world tasks from the perspective of the learner or is there simulation of this through certain case-based and problem-based real-life examples (Contextuality)?

1.6. Can learners transfer what they have learnt from that situation and context and apply that knowledge in other situations? Can learners utilize formerly learned knowledge and skills in the learning of new things? (Transferability)?

1.7. Is it possible for learners to articulate what the have learned and reflect on the thought processes entailed in the learning process and the decisions taken (Reflectivity)?

The foregoing pedagogical research problems served as the basis for the evaluation framework for the pedagogical evaluation of the learning environments. This is intended for the scrutiny of learning environments and learning from the learner-centered perspective, with consideration for the perspectives of both the learner and the teacher.

Main Results

Pilot projects in various fields constituted an important part of the ETÄKAMU activity. It was the aim of pilot work to try out the methods developed and elicit feedback on the technical and pedagogical functionality of the systems. In the field of piloting the focus was on the further development of the learning environments, on data collection and evaluation work. Pilot studies were implemented in ten fields in over twenty pilot projects. The following presents an overview of the main results from certain pilot projects.

A&O Open Learning Environment. The A&O learning environment is based on a space model that is divided into the following spaces: 1) *Office*, via which all administrative matters related to studies are carried out, 2) *Study* for students, teachers and other actors, 3) *Media Center*, where all the additional and reference materials are located and 4) *Gallery* where all the final works of the students can be set up to be available for all the Internet users. The system architecture of A&O consists of data management facilities including data acquisition tools, tools for communication and collaboration, course-dependent cognitive tools and authoring tools for producing hypermedia courseware. Since A&O is now just a research and development version, the authors have not yet been able to test the A&O learning environment in teaching experiments and user trials. These will be arranged in the future. (see Pohjolainen, Ruokamo & Nykänen 1999.)

Network PC. The pilot project Java in distance learning was implemented in the DMI Hypermedia Laboratory. It comprised TUT and three Tampere schools on the ATM network. Kaukajärvi School, Tampere Teacher Training School and Pyynikki School and also the joint network computer experimental environment. of Ylöjärvi Upper Secondary School. JavaStation was used to carry out teaching experiments in which it was noted that JavaStation is well-suited to use in educational institutions. (see Häkkinen in Ruokamo & Pohjolainen 1999.)

Pythagoras. The Pythagoras environment for statistics <URL: http://matriisi.ee.tut.fi/pythagoras/> is targeted at pupils of the secondary and upper secondary school. Experiments were carried out in numerous schools in the Tampere and Ylöjärvi areas. The outcomes of the experiments show that Pythagoras is viable as a learning environment for the study of statistics. The questionnaire-tool in Pythagoras was felt to be particularly good in that it enables users to publish their own questions on subjects which interest them on the web and also to collect answers from other users of the environment. It was possible for users to utilise the data they had themselves collected for subsequent project work. (see Mäenpää in Ruokamo & Pohjolainen 1999.)

New learning materials for schools (The KUOMA Pilot). The KUOMA learning environment and Environment Net <URL: http://matwww.ee.tut.fi/ymparistoverkko> were developed from the pilot project for the study of environmental subjects. EnvironmentNet was tried out in 1998 in Pyynikki School and in Ylöjärvi Upper Secondary School. The experiences gained from the experiment indicate that EnvironmentNet provides good opportunities for learner-centred learning. In order that optimal advantage be derived from these, more technical and pedagogical education would be necessary for teachers in using EnvironmentNet. Pupils, too, would require more orientation before beginning to study through EnvironmentNet. (Piiksi & Muhonen in Ruokamo & Pohjolainen 1999; Piiksi 1999.) On the same KUOMA pilot project the learning environment for elementary Russian was developed called Russian on the Net <URL: http://matwww.ee.tut.fi/venaja>. Russian on the Net was tried out in the Tampere Teacher Training School and Ylöjärvi Upper Secondary School. Results indicate that Russian on the Net brought variety and interest to the study of Russian, for teachers and pupils alike. Pupils reported that the environment was useful for learning, but there was still room for improvement. (Hämäläinen & Muhonen in Ruokamo & Pohjolainen 1999; Hämäläinen 1999.)

Web University (WU). On ETÄKAMU the international pilot Web University (WU) was developed. Web University pilot <URL: http://wwwcs.cern.ch/> operated as a virtual university through which it was possible to participate in real time and interactively in lectures of the Academic Training Programme by CERN and in CERN Colloquium seminars. International interest, and the further development and expansion of the pilot have shown that transmitting lectures by top experts is appropriate using broadband network-based, videoconferencing technique, and multimedia services. Distance learners have participated for a total of over 100 hours in two years in contact teaching realised through WU-mediated CERN contact teaching. Transmissions were in real time and were interactive. However, they were also recorded digitally on FUNET multimedia server <URL: http://mbase.funet.fi/>. (Rinta-Filppula 1998; Rinta-Filppula & Penttilä in Ruokamo & Pohjolainen 1999.)

Conclusions

The ETÄKAMU project developed many different learning environments for different target groups and learning contents; it also conducted a considerable number of teaching experiments. Most of the learning environments were available on the Internet. They utilized WWW hypermedia properties, the opportunities provided for situations and simulations. Communication and co-operation tools were also built into the environments, likewise cognitive and materials production tools. The activities and the experimental use made of the learning environments were successful and demonstrated the use and importance of technology in education. It was seen that technology can be used to aid the construction of pedagogically relevant environments and tools which support learning.

The rapid development in technology has been accompanied by certain problems. With the rapid development in browsers, plug-ins, script and programming languages and applications the computer network environment is not yet stable from the technical point of view. In consequence of this the existing learning environments must be constantly updated so that their operationality may be guaranteed. This problem may cause less trouble in the future, when the development in some respects reaches a plateau and commercial software dominates the markets.

Although hypermedia enables the construction and adaptability of documents there are as yet no systematic models of the structure of didactically appropriate learning material to be used more extensively. Standardization of the document structure would enable the use of content in different environments and facilitate both flexible combination of contents and information seeking. Material generated by both materials producers and learners constitutes an important part of the learning environment. Materials production would increase considerably if producers had at their disposal a user-friendly, structured tools for the production of multimedia material.

One obstacle to the expansion of the use of learning environments is the problems with use. Such problems are manifest in difficulty in use and the need for maintenance. For all actors a more user-friendly result could be achieved through better user connections and the integration of all necessary tools into the same learning environment.

In distance learning achieving objectives entails not only sophisticated technology but also appropriate pedagogy and contents - these must serve the same end of learner-centered learning. The new technology also provides scope for pedagogical progress and for the realization of pedagogical innovations. Efficient application of the existing technological options requires pedagogical research. An optimally efficient and meaningful learning environment commits the learners to active construction of knowledge instead of reproducing this. It further commits learners to discussion, interaction, co-operation and reflection of the parties in the learning process as opposed to the one-sided reception of knowledge or replication. The content of the learning environment should engage learners in meaningful contexts and situations in which it is possible to utilise knowledge and skills already acquired and to transfer these to further situations.

The pedagogical evaluation framework developed in the ETÄKAMU project proved functional in the evaluation of learning environments. It is also applicable in the planning and implementation of learning environments and in supporting learning. Of the seven qualities of learner-centred learning it was constructivity, intentionality and reflectivity which were found to be best realised in learning environments enabling project work. The learning environments were also found to enable contextuality and transferability. Activity and collaborativity were seen to pose challenges in many environments: what turned out to be problematic was how to get learners motivated and committed to the learning task and also to make active use each other's skills and knowledge.

The technologies available today enable totally new learning processes. In addition to the participation of traditional actors (teachers, educational institutions etc.) there are many kinds of new actors and producers of services such as teleoperators, producers of technical support services, producers of net materials, etc. The efficient and pedagogically sound use of learning environments requires overall control of the learning process. The dissemination of educational technology services developed in pilots and scaling them for more widespread use is a worldwide problem. The efficient dissemination of educational technology, contents and services requires that common rules of play be agreed on. This could be achieved by the dissemination of best practices and flexible standardising.

The efficient use of information technology (IT) in teaching in Finland is still at the experimental and pilot stages. Good experiments have been conducted but they need support in order to be realised. The risk exists that after experimentation, once the technical and pedagogical support personnel have departed, the environments used during the experiment will not continue to be part of the everyday practice of the educational institution or enterprise. The environments used in the experiments were neither technically nor pedagogically perfected products. There is a need for more user-friendly technologies to support learning, likewise appropriate content and more widely applicable models. Introducing and using learning environments should be easy, and not require great effort. Individual experiments should progress to more extensive nation wide trials and action models.

At schools resources should be invested in basic and further education for teachers so that they acquire the necessary competence to use take pedagogical and technical advantage of the learning environments and derive benefit from them. Those responsible for education in enterprises should also receive training through courses tailor made to suit their needs. At the present time the exploitation of IT in educational institutions is the responsibility of too small a number of active teachers. Maintenance of the schools' computer classes has proved problematic as there is a discrepancy between the time needed for this kind of work and the remuneration. Society should contribute adequately to improving the circumstances under which the new technology operates so that it can be introduced more rapidly.

The major developmental trends in education (see Carley & Dailey 1998) are: 1) sophisticated technology will play a greater role in education, 2) the role of commercialisation will increase, 3) the demands of lifelong learning and for educational services will be greater and 4) there will be redevelopment and reorganisation of education systems. The work on the research, development and evaluation of distance learning on the multimedia networks has served to promote these general trends, with a particular advance in the combination of technology and education. The increased demand for varied educational services has come strongly to the fore. With the help of learning environments which are independent of time and place it is possible to break out of limitations imposed by the classroom and individual educational institutions an offer new opportunities for training for companies and adults. Making these new opportunities a reality requires that in the long term the educational systems will be reformed. Due to the nature of the research and development project the role of commercial considerations was not accorded so much attention in the present research. Nevertheless the research findings of the ETÄKAMU project give good cause to make the transition from the phase of research and experimentation to product development which will be significant for international markets.

The activity of the project on distance learning in multimedia networks served as proof of the necessity of co-operation among the various actors in the development of educational technology and its exploitation. Co-operation between research units, educational institutions and enterprises, software and hardware manufacturers, content provider and teleoperators has been fruitful and has served to open new vistas. This valuable experience serves as a good point of departure for possible initiation of national and international projects in the future.

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An Intelligent Multimedia Tutor for English as a Second Language

MARIA VIRVOU, DIMITRIS MARAS
Department of Computer Science,
University of Piraeus,
Piraeus 18534, Greece
E-mail: mvirvou@unipi.gr | seagle@compulink.gr

Abstract: This paper is about an intelligent multimedia tutoring system of the passive voice of the English grammar. The system may be used to present theoretical issues about the passive voice and to provide exercises that the student may solve. While the student types the solution to an exercise, the system examines whether the answer has been correct and if not it attempts to diagnose what the cause of the mistake has been. The student's progress and usual mistakes are recorded to the student model. This kind of information may be used in the individualised error diagnosis of the student in subsequent sessions.

Key words: Intelligent Tutoring System, multimedia, student modelling, error diagnosis, language learning.

Overview

Students who learn English as a second language often experience problems in learning and consolidating the English grammar. The passive voice is an important topic which often seems difficult to students to use correctly. The problem is even greater in cases when the passive voice is not used extensively as a matter of style in the first language of students.

A multimedia tutor of the passive voice can be very useful if it incorporates intelligence so that it can help the student in correcting his/her mistakes and offer an individualised explanation for the cause of them. Many researchers point out (e.g. McGraw, 1994) that the integration of AI technologies and hypermedia may offer better support to students than any of these alone. The multimedia tutor that we have developed has been based on the techniques used in Intelligent Tutoring Systems (ITSs) (Wegner, 1987). Our system focuses on student error diagnosis in common with other systems in the domain of language teaching such as (Bos and Van De Plassche, 1994), (Heift, 1998) and (Kunichike et al., 1998).

In particular, the passive voice tutor constructs a student model which serves as a source of information that can be used for the interpretation of the student's actions and possible mistakes in solving exercises. The underlying cause of a mistake may be difficult for a tutoring system to spot. For example, Hollnagel (1991; 1993) makes an important distinction between the underlying cause or genotype of an error and the observable manifestation or phenotype of the error.

In the case of the passive tutor, error diagnosis is based on the student model where there have been recorded previous mistakes that the particular user has made and the progress that s/he has made since previous sessions. For example, if a student has been recorded to have been prone to spelling mistakes, then the system may use this piece of information for the interpretation of a mistake by favouring the cause of wrong spelling rather than lack of grammar knowledge at some points of the interaction.

Architecture of the Passive Voice Tutor

The architecture of the passive voice tutor follows the main line of Intelligent Tutoring Systems (ITS) architectures. Researchers in the area of ITSs (Hartley and Sleeman, 1973; Burton and Brown 1976; Wenger 1987) largely agree on the major functional components constituting an ITS architecture, namely the Domain Knowledge, the Student Modeller, the Advice Generator and the User Interface.

The domain knowledge of the passive voice tutor contains knowledge about how to convert a sentence from active to passive voice and vice versa. In addition, it contains knowledge about the dynamic construction of new sentences that can be used as exercises. The construction of new sentences is done using several lists of words, three of which are the most important. One for possible subjects, one for possible verbs and one for possible objects. All lists are semantically related among them so that sentences that do not make sense are not allowed. This kind of knowledge is used by the system so that the user is not shown the same exercises while running the program. The same kind of knowledge can also be used by the student or teacher for the creation of new exercises that can be answered by the system as an example or can be used as new homework for the students.

The student modeller compares the solution that a student has given to that of the system and if these do not match it performs error diagnosis. There are several categories of error that may be recognised, for example spelling mistakes, accidental slips, mistakes in the actual conversion of passive to active voice, mistakes in the use of tenses, etc. The student modeller is also responsible for recording statistics about each student's performance. For example, the system records the percentage of the exercises that have been correctly answered, the percentage of spelling mistakes etc. This kind of information is also used in error diagnosis to create an individualised interpretation of a user's error.

The advice generator is responsible for acting in the most appropriate way in every situation. For example, if a student has made a mistake which is relevant to the use of verb tenses then the advice generator will show to the student the part of the theory that deals with this subject.

Finally, the multimedia user interface involves animations, sounds and a limited form of natural language so that it can attract the student's interest in the subject.

Overall Performance

The overall performance of the passive voice tutor may be summarised in the following functions which may be selected from the main menu of the system:

- **Theory:** At this point the student may read the theoretical issues that are relevant to passive voice.
- **Solving Exercises:** At this point the student may start interacting with the system in solving exercises. The student is given four types of exercise to select from:

  1) Multiple choice exercises.
  2) Exercises where the user is asked to rewrite a sentence using passive voice.
  3) Exercises where the user is asked to rewrite a sentence using active voice.
  4) A puzzle.

The way that multiple choice exercises have been constructed is based on an empirical study that has been conducted in real classrooms and through interviews with students and teachers. The results of this particular study have shown what the most common students' mistakes are. This kind of information has been used throughout the creation of the erroneous answers that have been incorporated in the multiple choice questions development. Furthermore, the above results have been used for the analysis of possible students' mistakes in the design of the diagnostic component of the student modeller.

In the case of exercises where the student is asked to rewrite a sentence using passive voice, the student is given a sentence in the active voice and s/he is asked to retype the sentence in the passive voice. At this kind of exercise, the system ignores trivial typographic errors such as the absence of a fullstop at the end of the sentence, absence of any space between words, redundant spaces or commas, etc. If the student has made an error other than a trivial typographic errors, then the system performs error diagnosis taking into account information that has been collected about the specific user in previous interactions as well as common mistakes that have been classified in several categories of error. There are seven types of errors that may be recognised by the system:

1) **Accidental slips**
   For example, the student may have deleted some words and may have forgotten to complete the sentence.
2) **Spelling mistakes**
   A spelling mistake occurs when the user has typed the expected word so that one letter is redundant or missing or two neighbouring letters have been interchanged. For example, the student has typed "mather" instead of "mother".
3) **Article mistakes**
   For example, the user may have used "a" instead of "an".
4) **Conversion mistakes**
   For example, the user may have not converted the active verb "write" to the past participle "written".
5) **Irregular verb mistakes**
   The user may have used the usual ending "-ed" to create the past participle of an irregular verb (for example s/he may have typed "buyed" instead of "bought").
6) **Noun mistakes**
   For example the user may have typed "book" instead of "books".
7) **Verb tense mistakes**
   For example the user may have typed "been" instead of "being".

In some cases a mistake of the user may be attributed to more than one categories of error. For example, if a student has not typed the word "by" in the converted sentence, this could be either accidental slip or a conversion mistake. In this case, the former is rather superficial whereas the latter is deeper and shows that the student has not consolidated the knowledge about passive voice. In cases like this the system takes into account the individual features of the user, that have been recorded in previous interactions, in order to formulate the kind of advice to give to the student. For example, if the particular student has not previously made conversion mistakes but has made carelessness mistakes then the system favours carelessness as the most probable cause of the mistake.

Examples of interactions involving students' errors are the following:

First Example

System exercise:	My sister has bought this book.
Student's answer:	This book has been bouht by my sister.
System:	You have made a spelling mistake in the past participle. You should have written "bought" instead of "bouht". Please try again.

Second Example

System exercise:	My sister has bought this book.
Student's answer:	This book has been bought my sister.
System:	Neither "by" nor "with" was found in your sentence. Please notice that we use one of these words in passive voice for the agent. Please read again the theory and try again.

In this example the system has considered the error as a conversion mistake. Alternatively, it could have considered the same mistake as a carelessness error. However, in this case it must not have had sufficient information that the student knows how to use "by" or "with".

Third Example

System exercise:	My sister will buy this book.
Student's answer:	My sister will be bought by a book.
System:	You have made a serious conversion error. Please notice that in passive voice the subject and object should exchange places. Please read again the theory and try again.

In the case of exercises where the user is asked to rewrite a sentence using active voice the function of the system is similar to that of exercises that were explained above. The only difference is that the initial sentence is given in passive voice this time.

Finally, the type of exercise called "puzzle" is a kind of game that the student may play, so that s/he can consolidate knowledge while having fun. This feature is quite important pedagogically because it stimulates student's interest. As (Amory et al., 1998) point out while students learn equally from playing games and traditional practical material, they find playing games more enjoyable and hence they attempt more interactions.

- **Creating Exercises/Examples:** At this point the student is shown exercises again, only this time s/he is the one who creates the exercises and the system solves them as an example. The student may create sentences in active voice by selecting subjects, verbs and objects from three lists respectively. Then the student may select articles or pronouns, singular or plural for the subject and object as well as tense for the verb. If the created sentence does not make sense or is not correct then the system gives a message to the user to let him/her know about the problem. If the sentence is fine then the system rewrites the sentence using passive voice, so that the student can see how this is done.
- **Statistics:** The student is allowed to see the statistics about his/her performance, which have been recorded by the system. In addition, s/he may ask to have a printed report. The student can see the statistics about his/her overall performance in all the sessions that s/he has attempted or just in the current session. S/he may also see the comparison between his/her overall performance and the performance in the current session or the comparison between performances in the current session and the previous one.

An example of statistics about a user's overall performance is the following:

Student name: John
In a total of 25 exercises:

Correct sentences:	65.5%
Sentences having spelling mistakes:	12.5%
Sentences having mistakes due to carelessness:	25%
Conversion mistakes:	0%

In the case of the above example in a subsequent session of the student called John, the system will favour the cause of carelessness for a mistake rather than lack of grammar knowledge in cases where either of them could be considered.

Conclusions

The passive voice tutor is a multimedia system that combines user-friendliness with intelligence in interaction. It offers individualised advice to users when they make errors after it has performed error diagnosis. It has a mechanism for choosing between different possible causes underlying an error which vary from trivial typographic errors to deeper misconceptions concerning the main topic that is being taught. The design of the diagnostic component has been based on an empirical study that has been held in real classrooms and has shown what the most common students' mistakes are.

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EasyMath: A multimedia Tutoring System for Algebra

Maria Virvou, Victoria Tsiriga
Department of Computer Science,
University of Piraeus,
Piraeus 18534, Greece
E-mail: {mvirvou | vtsir}@unipi.gr

Abstract: This paper describes a multimedia tutoring system for Algebra. The system is called "EasyMath" and it incorporates intelligence. One of the primary aims of EasyMath is its usefulness in school classrooms, therefore school teachers of mathematics have been involved throughout the life cycle of EasyMath. The design of EasyMath has been based on the results of an empirical study that was conducted at schools and the resulting product was evaluated by school-teachers as well as students. EasyMath incorporates techniques from Intelligent Tutoring Systems. In particular, it takes a reconstructive approach to student modelling and error diagnosis, which uses a generic model of the domain for the reconstruction of correct and incorrect solutions to exercises. EasyMath provides a facility for the dynamic construction of new exercises for students on which it can perform error diagnosis and provide appropriate advice. EasyMath has been evaluated by school teachers and students. The results of the evaluation show that the multimedia interface provides a user-friendly interactive environment which seems more attractive to students than conventional teaching methods. In addition, EasyMath's intelligence guarantees more individualised advice with high relevance to the context and problems of the students.

Key words: Intelligent Tutoring Systems, Multimedia, Student Modelling, Error Diagnosis.

Overview

This paper describes a multimedia educational system for Algebra. The system is called EasyMath. One of the main aims of EasyMath is its usefulness in the environment of school classrooms in common with other projects such as (Alexandris et al., 1998). Therefore school teachers have been involved in the phases of requirements analysis and evaluation of EasyMath's life cycle.

In particular, during the requirements analysis, an empirical study was conducted involving 4 school teachers and 240 students of 8 different classes of the same grade. The results of the empirical study showed what the most common misconceptions of students have been concerning Algebraic powers. These misconceptions have served as the basis for the design of the student modelling component of EasyMath. The empirical study is described in more detail in the next section.

The evaluation phase of EasyMath involved 4 school teachers who were different from the ones involved in the empirical study. EasyMath was also evaluated by a total of 180 students of 6 different classes of the same grade. The evaluation is described in more detail in a subsequent section.

EasyMath incorporates techniques from Intelligent Tutoring Systems (Wenger, 1987). It follows the main line of an ITS architecture which consists of four major components, namely the domain knowledge, the student modeller, the advice generator and the user interface. ITSs have often been criticized that in spite of their superiority to traditional stand up training they may miss the mark in terms of task reality, feasibility and effectiveness (McGraw, 1994). However, there have been quite a lot of successful evaluations of ITSs (e.g. Marks & Greer, 1991) and reports on the successful use in classrooms of ITSs (e.g. Koedinger & Anderson, 1993).

The design of EasyMath has been based on techniques of ITSs that can be useful to the improvement of the quality of multimedia educational software both for the student and the teacher. In particular, the student modelling component has been based on reconstructive approaches to error diagnosis which have been used in many ITSs such as (Langley et al., 1987; Sleeman et al., 1990; Hope, 1994). These systems reconstruct the problem solving process and generate mal-rules from hypothesized faulty solution paths which are used for the modelling of students' misconceptions or procedural bugs. In the case of EasyMath, the most common faulty solution procedures, which were identified in students' transcripts during the empirical study, have been encoded in the student modelling component.

These faulty solution procedures are used for two purposes:

1) For the construction of new multiple choice tests where the wrong answers have been generated by the use of these faulty procedures.
2) For diagnosing what the cause of a student error may have been while s/he is solving an exercise.

Finally, EasyMath's multimedia interface renders the system quite attractive to students. The evaluation results have shown that students particularly liked an educational game that EasyMath incorporates and which makes full use of multimedia facilities such as animations, sounds, etc.

Empirical Study

EasyMath's design has been based, to a large extent, on the results of an empirical study that involved school-teachers and students. These results were particularly useful for the requirements analysis of EasyMath as they showed what teachers would like the software to do to help them in the class. In addition, they showed what particular pieces of the domain knowledge seem difficult to students to comprehend fully and what misconceptions they may have while learning.

Educational software should be used to supplement human teachers and not substitute them, therefore human teachers should be involved in the development process. Besides, as Mark and Greer (1993) point out, the accuracy of ITS components such as domain knowledge should be ensured before a system is completed and assumed thereafter. One good way of ensuring this accuracy is to involve human teachers in the early stages of the development process.

The empirical study involved 4 school-teachers. Each school-teacher taught 2 different classes of the same grade. Each class consisted of 30 students. All students of every class were involved in the empirical study. This gave a total of 240 students who were involved in the empirical study.

All students were given the same tests which were made by the 4 teachers in collaboration. These tests covered all the material taught in Algebraic powers. The results of these tests were analysed so that as many as possible errors could be categorized. As a result of the analysis, the most common categories of error were identified and the cause of them was diagnosed by the human teachers.

For example, for the multiplication of powers, the following most common categories of error were identified:

- If both powers have positive bases as well as exponents, the user may multiply instead of adding the exponents. For example, $4^3 * 4^6 = 4^{18}$ instead of 4^9.
- In the case when both powers have positive bases as well as exponents, the user may multiply the bases instead of leaving the same base. For example, $3^4 * 3^5 = 9^9$ instead of 3^9.
- When both powers have positive bases as well as exponents, the user may multiply the bases instead of leaving the same base in addition to multiplying instead of adding the exponents. For example, $2^3 * 2^5 = 4^{15}$ instead of 2^8.
- If one of the powers has a negative exponent and the other has a positive exponent, but both of them have the same bases, the student may subtract instead of adding the exponents. For example, $5^3 * 5^{-4} = 5^7$ instead of 5^{-1}.
- The user may make a careless mistake either in entering the base or the exponent of the answer. For example, $4^3 * 4^6 = 5^9$ instead of 4^9.
- When the student is asked to multiply a power with a number that can be converted to a power, s/he may make mistakes both while converting the number into a power as well as while multiplying the two powers. For example $2^3 * 8 = 16^3$ or $2^3 * 8 = 2^9$ instead of 2^6.

The identified most common categories of error, their causes and appropriate advice for each category were encoded to EasyMath's domain knowledge, student modeller and advice generator.

Overall design of EasyMath

EasyMath has been designed to be used by students and/or teachers. Students may use EasyMath to read theoretical lessons about Algebraic powers and solve exercises. Teachers can use EasyMath as an assisting tool for the creation of new exercises, which can serve as student tests.

The various ways that a student and/or a teacher can use EasyMath are represented as different modes of function:

- **Lecturing mode:** In this mode, the student is able to read theoretical issues concerning algebraic powers.
- **Solving exercises mode:** In this mode, the student is presented several exercises to solve. EasyMath constructs dynamically new exercises of different levels of difficulty, starting from the first level to higher levels.

  For example, in the multiplication of powers, the first level of difficulty comprises exercises where the student is asked to convert to a power a number which is multiplied by itself several times. For example, $3 * 3 * 3 * 3 * 3 = 3^5$. The number which is multiplied as well as the number of factors of the multiplication are generated randomly and they are different each time a student attempts this type of exercise.

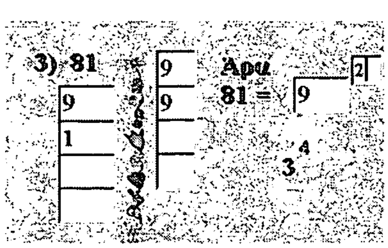
  A higher level of difficulty includes exercises where the multiplication factors are negative numbers. The different sign of factors renders this type of exercise more difficult than that of the first level and so on.

  For every type of exercise, EasyMath contains knowledge about how to solve it correctly and how to solve it in several faulty ways that represent the most common errors that were identified in the empirical study for the particular type of exercise.

  If a student gives an answer which is correct then EasyMath congratulates him/her and allows him/her to proceed to next level of difficulty. If a student gives an erroneous answer then EasyMath tries to perform error diagnosis by generating the faulty procedures of solution. If one of them is found to match the student's answer then EasyMath shows to the user the appropriate kind of advice and records the type of error identified in the student's personal record so that it can have the history of his/her progress.

  The way that EasyMath performs error diagnosis is based on reconstructive methods of student modelling. For example, while a student converts a number into a power, s/he may make the following types of error:

1. Error in the factorization of a number to prime numbers. This error can occur due to an erroneous conduction of the needed divisions as well as a division with a number that is not the smallest prime number. For example, while factorizing the number 81 to its prime numbers, the student may divide the number by 9, which is not a prime number. As a consequence of this type of an error, the base of the power that is given as an answer is wrong, 9 instead of 3 in the example. An example of this kind is shown in [Figure 1a] where the student's answer is 9^2 instead of 3^4 which is the correct answer.
2. Correct factorization of the number but erroneous transformation to a power. For example, the student after factorizing correctly the number 125 to its prime numbers, s/he has a misconception in identifying which of the numbers is the base and which is the exponent. This may result in a mistake such as entering a base different from 5 or an exponent different from 3. An example of this kind is shown in [Figure 1b] where the student's answer is 5^2 instead of 5^3 which is the correct answer.



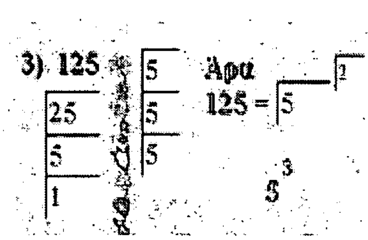


Figure 1a: One case of erroneous answer **Figure 1b:** Another case of erroneous answer

In the case when the student's answer is of the type that is illustrated in [Figure 1a], the system's answer is: "*There has been an error in the factorization procedure, because the number used as a base is not a prime number.*"

In the case when the student's answer is of the type that is illustrated in [Figure 1b], the system's answer is: "*The factorization procedure is correctly completed, but there has been an error while constructing the power.*"

- **Answering multiple choice questions:** In this mode, EasyMath constructs dynamically a new set of multiple choice questions which are presented to the user. The construction of multiple choice questions is based on domain knowledge and the student model.

  Numbers that serve as bases or exponents are generated randomly. For each type of question there is one procedure that solves the exercise correctly and there is a number of faulty procedures that have been encoded to the system, which represent common students' mistakes. The result of the correct procedure is used as the correct answer in the multiple choice. Erroneous answers are generated from the faulty procedures that are encoded into the system. For each question, a number of faulty procedures are selected randomly from the whole set of faulty procedures.

  For example, when the system issues a question concerning the multiplication of powers, it performs the following steps:

  1) A number within the range [1, 9] is generated randomly, in order to serve as the base of the two powers to be multiplied.
  2) Two numbers within the range [1, 9] are generated randomly, in order to form the exponents of the two powers.

  After the generation of the question that will be shown to the student, the system chooses randomly two out of the seven possible erroneous procedures and based on them, it constructs the two wrong answers that would serve as alternative answers to the problem that the user has to solve.

  An example of a multiple choice question is the following:

  $6^3 * 6^{-5} = ?$
  a. 36^{-2}
  b. 6^{-2}
  c. 6^{-15}

  In this case, the correct answer is b. However, if the student selects a, then EasyMath prompts him/her with the message:

  "Identified problem in the multiplication of powers: you have multiplied the bases instead of leaving the same base."

  If the student selects c, then EasyMath prompts him/her with the message:

  "Identified problem in the multiplication of powers: you have multiplied instead of adding the exponents."

- **Game playing mode:** In this mode, the student is given a game which is relevant to algebraic powers. This mode is quite important pedagogically. As (Amory et al., 1998) point out, games appear to motivate students intrinsically and represent one of the best uses of multimedia in education.
- **Assistance in the creation of new exercises:** In this mode, the teacher can profit from the domain knowledge and student modeller to create new multiple choice exercises and other exercises concerning algebraic powers. For example, the teacher types in a new question which is solved by the system correctly and in all possible faulty ways that EasyMath knows. Then the teacher is

presented with faulty results and algorithms so that s/he can select the erroneous answers for the multiple choice question.

Evaluation

EasyMath was evaluated by 4 school-teachers and a total of 180 students. The 4 teachers who participated in the evaluation were different from the teachers who were involved in the empirical study. They were asked to use EasyMath and then answer a questionnaire. Students constituted 6 different classes of the same grade. Each class consisted of 30 students. The evaluation by students was done in two phases. In the first phase 120 students of 3 different classes of the same grade were asked to use the software and then answer a questionnaire which included questions that are illustrated in [Table 1].

Question	Agreement	Lack of preference	Disagreement
1. Do you think that using EasyMath makes learning more like a game?	95%	1%	4%
2. Were graphics of EasyMath attractive?	97%	0%	3%
3. Were the colors and text used by EasyMath convenient?	90%	3%	7%
4. Has the use of sounds in EasyMath enhanced attention?	92%	2%	6%
5. Were you satisfied with the responses to students' errors?	98%	1%	1%
6. Do you believe that the domain of Algebraic powers was fully covered?	66%	15%	19%
7. Was the amount of different exercises enough?	93%	3%	4%
8. Were you pleased by the way student's progress has been recorded and used?	89%	3%	8%
9. Was it easy to get familiar to using EasyMath?	94%	4%	2%
10. Was it easy to trick EasyMath?	84%	1%	15%

Table 1: Questionnaire.

EasyMath's quality features evaluated	Corresponding questions from questionnaire	Average Score
Friendliness and Attractiveness of the Graphical User Interface	1, 2, 3, 4, 9	93.6%
Completeness of the Domain Knowledge	6, 10	75%
Correctness of the interactive student solution checker	8, 10	86.5%
Relevance of the advice provided when solving exercises	5, 10	91%
Sufficiency of range of exercises provided	7	93%

Table 2: Summary of results of evaluation.

Answers to the questions of the questionnaire (Table 1) were used to evaluate certain quality features of EasyMath as shown in Table 2. In this table the first column illustrates the quality features evaluated. In the second column we give the corresponding questions from the questionnaire which were used for the evaluation of the respective quality features. Finally, in the third column we give the score which has resulted from the average of the provided answers to the corresponding questions, as it appears in the "Agreement" column of Table 1. For example, in the friendliness and attractiveness of the GUI we take the average of the answers that represent the agreement percentage for questions 1, 2, 3, 4 and 9, namely 95%, 97%, 90%, 92% and 94% respectively. The resulted average score is 93.6%.

In the second phase 120 students, other than the 120 students who participated in the first phase, were taught half of the syllabus in algebraic powers without the use of EasyMath and they were given a written test. Then they used EasyMath while being taught the rest of the syllabus. In the end they were given another written test and the grades of their first and second test were compared. 46% of the students obtained a better grade in the second test, 43% obtained the same grade and only 11% obtained a lower grade in the second test.

Conclusions

Multimedia interfaces when combined with the reasoning capabilities of Intelligent Tutoring Systems can provide attractive, user-friendly environments for learning, which can interact with the student in an individualized way. This kind of educational software can be useful to classrooms if it provides assistance to teachers and helps students in the learning process. These qualities can be achieved to a high degree if school-teachers participate in the development of educational software.

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Automated Essay Scoring: Applications to Educational Technology

Peter W. Foltz
Dept. of Psychology,
Box 30001, Dept. 3452
New Mexico State University
Las Cruces, NM, 88003 USA
pfoltz@crl.nmsu.edu

Darrell Laham
Knowledge Analysis Technologies
4001 Discovery Drive, Suite 390-A6
Boulder, Colorado, 80303
dlaham@knowledge-technologies.com

Thomas K Landauer
Dept. of Psychology
Box 344
University of Colorado
Boulder, CO 80309
landauer@psych.colorado.edu

Abstract: The Intelligent Essay Assessor (IEA) is a set of software tools for scoring the quality of essay content. The IEA uses Latent Semantic Analysis (LSA), which is both a computational model of human knowledge representation and a method for extracting semantic similarity of words and passages from text. Simulations of psycholinguistic phenomena show that LSA reflects similarities of human meaning effectively. To assess essay quality, LSA is first trained on domain-representative text. Then student essays are characterized by LSA representations of the meaning of their contained words and compared with essays of known quality on degree of conceptual relevance and amount of relevant content. Over many diverse topics, the IEA scores agreed with human experts as accurately as expert scores agreed with each other. Implications are discussed for incorporating automatic essay scoring in more general forms of educational technology.

Introduction

While writing is an essential part of the educational process, many instructors find it difficult to incorporate large numbers of writing assignments in their courses due to the effort required to evaluate them. However, the ability to convey information verbally is an important educational achievement in its own right, and one that is not sufficiently well assessed by other kinds of tests. In addition, essay-based testing is thought to encourage a better conceptual understanding of the material on the part of students and to reflect a deeper, more useful level of knowledge and application by students. Thus grading and criticizing written products is important not only as an assessment method, but also as a feedback device to help students better learn both content and the skills of thinking and writing. Nevertheless, essays have been neglected in many computer-based assessment applications since there exist few techniques to score essays directly by computer. In this paper we describe a method for performing automated essay scoring of the conceptual content of essays. Based on a statistical approach to analyzing the essays and content information from the domain, the technique can provide scores that prove to be an accurate measure of the quality of essays.

The text analysis underlying the essay grading schemes is based on Latent Semantic Analysis (LSA). Detailed treatments of LSA, both as a theory of aspects of human knowledge acquisition and representation, and as a method for the extraction of semantic content of text are beyond the scope of this article. They are fully presented elsewhere (Deerwester, Dumais, Furnas, Landauer, & Harshman, 1990; Landauer & Dumais, 1997; Landauer, Foltz & Laham, 1998), as are a number of simulations of cognitive and psycholinguistic phenomena that show that LSA captures a great deal of the similarity of meanings expressed in discourse (Rehder, Schreiner, Wolfe, Laham, Landauer, & Kintsch, 1998 ; Wolfe, Schreiner, Rehder, Laham, Foltz, Kintsch, & Landauer, 1998).

Based on a statistical analysis of a large amount of text (typically thousands to millions of words), LSA derives a high-dimensional semantic space which permits comparisons of the semantic similarity of words and passages. Words and passages are represented as vectors in the space and their similarity is measured by the cosine of their contained angle in the semantic space. The LSA measured similarities have shown to closely mimic human judgments of meaning similarity and human performance based on such similarity in a variety of ways. For example, after training on about 2,000 pages of English text, it scored as well as average test-takers on the synonym portion of TOEFL—the ETS Test of English as a Foreign Language (Landauer & Dumais, 1997). After training on an introductory psychology textbook, it achieved passing scores on two different multiple-choice exams used in introductory psychology courses (Landauer, Foltz & Laham, in preparation). This similarity comparison made by LSA is the basis for performing automated scoring of essays through comparing the similarity of meaning between essays.

Automated scoring with LSA

While much of the emphasis on evaluating written work has examined mechanical features, such as grammar, spelling and punctuation, there are other factors involved in writing a good essay. For example at an abstract level, one can distinguish three properties of a student essay that are desirable to assess; the correctness and completeness of its contained conceptual knowledge, the soundness of arguments that it presents in discussion of issues, and the fluency, elegance, and comprehensibility of its writing. Evaluation of superficial mechanical and syntactical features is fairly easy to separate from the other factors, but the rest—content, argument, comprehensibility, and aesthetic style—are likely to be difficult to pull apart because each influences the other, if only because each depends on the choice of words.

Although previous attempts to develop computational techniques for scoring essays have focused primarily on measures of style (e.g., Page, 1994), indices of content have remained secondary, indirect and superficial. In contrast to earlier approaches, LSA methods concentrate on the conceptual content, the knowledge conveyed in an essay, rather than its style, or even its syntax or argument structure.

To assess the quality of essays, LSA is first trained on domain-representative text. Examples of domain-representative texts include textbooks, articles or samples of writing that a student would encounter during learning in that domain. Based on this training, LSA derives a high-dimensional semantic representation of the information contained in the domain. Words can be represented as vectors in this semantic space, with the semantic similarity between words characterized by the cosine of the angle between the vectors for those words. Similarly, student essays can be characterized by LSA vectors based on the combination of all their words. These vectors can then be compared with vectors for essays or for texts of known content quality. The angle between the two vectors represents the degree to which the two essays discuss information in a similar manner. For example, an ungraded essay can be compared to essays that have already been graded. If the angle between two essays is small then those essays should be similar in content. Thus, the semantic or conceptual content of two essays can be compared and a score derived based on their similarity. Note that two essays can be considered to have almost identical content, even if they contain few or none of the same words, as long as they convey the same meaning. This feature of the comparison illustrates that LSA is doing more than just keyword matching; it is matching based on the conceptual content in the essays.

Evaluating the effectiveness of automated scoring

Based on comparing conceptual content, several techniques have been developed for assessing essays. Details of these techniques have been published elsewhere and summaries of particular results will be provided below. One technique is to compare essays to ones that have been previously graded. A score for each essay is determined by comparing the essay against all previously graded essays. The scores from some number of those pre-graded essays (typically 10) that are most similar to the essay are weighted by their cosine similarity to the essay and used determine the score for the essay This technique provides a "holistic" score measuring the overall similarity of content (Laham, 1997; Landauer, Laham, Rehder, & Schreiner, 1997). The score is holistic in that the grade for an essay is determined based on how well the overall meaning of an essay matches that of previously graded essays.

The holistic method has been tested on a large number of essays over a diverse set of topics. The essays have ranged in grade level, including middle school, high school, college and college graduate level essays. The topics have included essays from classes in introductory psychology, biology, history, as well as essays from standardized tests, such as analyses of arguments, and analyses of issues from the Educational Testing Service (ETS) Graduate Management Achievement Test (GMAT). For each of these sets of essays, LSA is first trained on a set of texts related to the domain. Then the content of each of the new essays is compared against the content of a set of pre-graded essays on the topic. In each case, the essays were also graded by at least two course instructors or expert graders, for example professional readers from Educational Testing Service, or other national testing organizations. Across the datasets, LSA's performance produced reliabilities within the range of their comparable inter-rater reliabilities and within the generally accepted guidelines for minimum reliability coefficients. For example, in a set of 188 essays written on the functioning of the human heart, the average correlation between two graders was 0.83, while the correlation of LSA's scores with the graders was 0.80. A summary of the performance of LSA's scoring compared to the grader-to-grader performance across a diverse set of 1205 essays on 12 topics is shown in Figure 1. The results indicate that LSA's reliability in scoring is equivalent to that of human graders.

In a more recent study, the holistic method was used to grade two additional questions from the GMAT standardized test. The performance was compared against two trained ETS graders. For one question, a set of 695 opinion essays, the correlation between the two graders was 0.86, while LSA's correlation with the ETS grades was also 0.86. For the second question, a set of 668 analysis of argument essays, the correlation between the two graders was 0.87, while LSA's correlation to the ETS grades was 0.86. Thus, LSA was able to perform at the same reliability levels as the trained ETS graders.

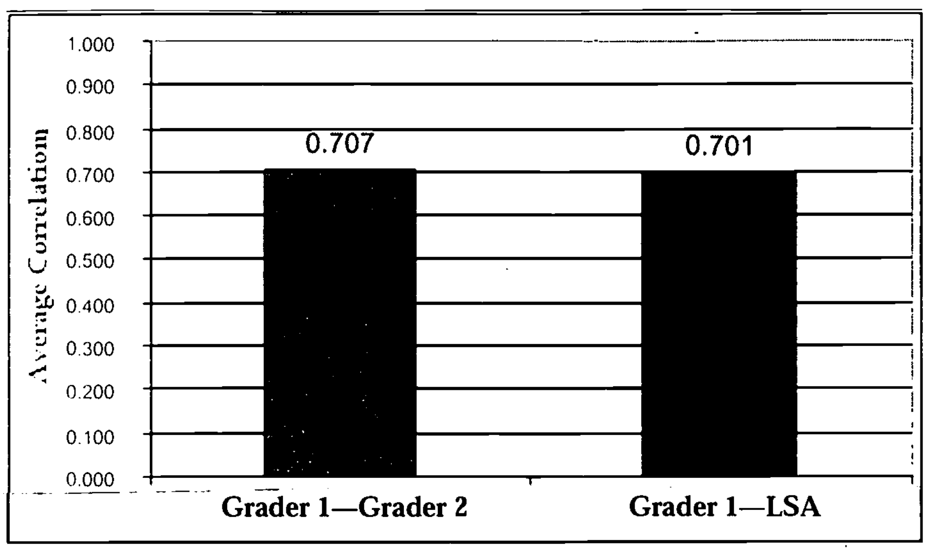

Figure 1. Summary of reliability results (N = 1205 Essays on 12 Diverse Topics)

While the holistic technique relies on comparing essays against a set of pre-graded essays, other techniques have been developed that also effectively characterize the quality of essays. A second technique is to compare essays to an ideal essay, or "gold standard" (Wolfe et al., 1998). In this case, a teacher can write his or her ideal essay and all student essays are then judged based on how close they are to the teacher's essay. In two final techniques, essays can be compared to portions of the original text, or compared to sub-components of texts or essays (Foltz, 1996; Foltz, Britt & Perfetti, 1996). In this final componential approach, individual sentences from a student's essay can be compared against a set of predetermined subtopics. This permits the determination of whether an essay sufficiently covers those subtopics. LSA derived scores based on the degree of coverage of subtopics in essays show equivalent correlations with human graders as graders correlate with each other

Anomalous essay checking

While it is important to verify the effectiveness of computer-based essay grading, it is also important that such a grader be able to determine if it can not grade an essay reliably. Thus, a number of additional techniques have been developed that can detect "anomalous" essays. If an essay is sufficiently different from the essays for which it has been trained, the computer can flag it for human evaluation. We currently flag ones that are highly creative, off topic, or violate standard formats or structures for essays. In addition, the computer can determine whether any essay is too similar to other essays or to the textbook. The program is thus able to detect different levels of plagiarism. If an essay is detected as being anomalous for any reason, the essay can be automatically forwarded to the instructor for additional evaluation.

Experiences in the classroom: grading and feedback

Over the past two years, the Intelligent Essay Assessor has been used in a course in Psycholinguistics at New Mexico State University. Designed as a web-based application, it permits students to submit essays on a particular topic from their web browsers. Within about 20 seconds, students receive feedback with an estimated grade for their essay and a set of questions and statements of additional subtopics that are missing from their essays. Students can revise their essays immediately and resubmit. A demonstration is available at: http://psych.nmsu.edu/essay

To create this system, LSA was trained on portion (four chapters) of the psycholinguistics textbook used in the class. The holistic grading method was used to provide an overall grade for any essay. In this method, each essay was compared against 40 essays from previous years that had been graded by three different graders. To verify the effectiveness of this approach for providing accurate grades, the average correlation among the three human graders was 0.73 while the average correlation of LSA's holistic grade to the individual graders was 0.80. To provide feedback about missing information in each essay, individual sentences in each essay were compared against sentences that corresponded to subtopics of the essay topic. If no sentence was found that matched a subtopic then the student received feedback about the fact that their essay did not properly cover that subtopic.

Students were permitted to use the system independently to write their essay and were encouraged to revise their essays and resubmit them to the computer as many times as they wanted until they were satisfied with their grades. The average grade for the students' first essays was 85 (out of 100). By the last revision, the average grade was 92. Students' essays improved from revision to revision, with the improvements in scores ranging from 0 to 33 points over an average of 3 revisions. An additional trial is underway with a similar system in a Boulder Colorado middle school in which students summarize texts on sources of energy. Preliminary results indicate that two-thirds of the students were able to improve their summaries based on the IEA's feedback.

In both the undergraduate and middle school trials, students and teachers have enjoyed and valued using the system. A survey of usability and preferences for/against the system in the psycholinguistics course showed that 98 percent of the students indicated that they would definitely or probably use such a system if it were available for their other classes. Overall, the results show that the IEA is successful at helping students improve the quality of their essays through providing immediate and accurate feedback.

Implications of computer-based essay grading for education

There exist a variety of applications within education to which the IEA can be applied. At a minimal level, the IEA can be used as a consistency checker, in which the teacher grades the essays and then the IEA re-grades the essays and indicates discrepancies between the two grades. Because the IEA is not influenced by fatigue, deadlines, or biases, it can provide a consistent and objective view of the quality of the essays. The IEA can further be used in large scale standardized testing or large classes, by either providing consistency checks or serving as an automatic grader.

At a more interactive level, the IEA can be used to help students improve their writing through assessing and commenting on their essays. By providing instantaneous feedback about the quality of their essays, as well as indications of information missing from their essays, students can use the IEA as a tool to practice writing content-based essays. Due to a lack of sufficient teachers and aides in many large section courses, writing assignments and essay exams have often been replaced by multiple choice questions. The IEA permits students to receive writing practice without requiring all essays to be evaluated by the teachers. Because the IEA's evaluations are immediate, students can receive feedback and make multiple revisions over the course of one session. This overall approach is consistent with the goals of the "Writing across the Curriculum" approach by allowing the introduction of more writing assignments in courses outside of English or the humanities. Thus, the IEA can serve to improve learning through writing.

Finally, the IEA can be integrated with other software tools for education. In most software for distance education, tools for administering writing assignments are often neglected in favor of tools for creating and grading multiple choice exams. The IEA permits writing to be a more central focus. For example, in web-based training systems, the IEA can be incorporated as an additional module which would permit teachers to add writing assignments for their web courses. Essays can be evaluated on a secure server and scores can be returned directly either to the students or to the teachers along with the essays. Textbook supplements can similarly use the IEA for automated study guides. At the end of chapters, students can be asked to write essay questions addressing topics covered in the chapter. Based on an analysis of their essays, the software can suggest sections of the textbook that the students needs to review before they take their exams.

Conclusions

To summarize the process of grading with the IEA, the IEA is first trained on some domain representative text such as a textbook, samples of writings, or even a large number (300 or more) essays on a topic. Second, the IEA is provided with one or more pre-graded essays on the topic to be graded. Once these pieces of information are processed, the IEA is able to provide accurate characterizations of the quality of essays on the same topic. Domain representative texts are easily available in electronic form and essays can now be easily converted or directly entered by students in electronic form. Thus, it is highly feasible to develop automated essay graders for a large number of topics across many domains. Although the IEA requires a large amount of computer processing power, it can be run from a centralized server, allowing students to access it from any web browser.

The Intelligent Essay Assessor presents a novel technique for assessing the quality of content knowledge expressed in essays. It permits the automatic scoring of short essays that would be used in any kind of content-based courses. Based on evaluations of the IEA over a wide range of essay topics and levels, the IEA proves as reliable at evaluating essay quality as human graders. Its scores are also highly consistent and objective. While the IEA is not designed for assessing creative writing, it can detect whether an essay is sufficiently different that it should be graded by the instructor. The IEA can be applied for both distance education and for training in the classroom. In both cases it may be used for assessing students content knowledge as well as providing feedback to students to help improve their learning. Overall, the IEA permits increasing the amount of writing assignments without overly increasing the grading load on the teacher. Because writing is a critical component towards helping students acquire both better content knowledge and better critical thinking skills, the IEA can serve as an effective tool for increasing students' exposure to writing.

Acknowledgements

The web site http://www.knowledge-technologies.com provides essay scoring demonstrations as well as information on the commercial availability of the IEA for educational software. The web site http://lsa.colorado.edu provides other demonstrations of the essay grading, additional applications of LSA and links to many of the articles cited. This research was supported in part by a contract from the Defense Advanced Research Projects Agency-Computer Aided Education and Training Initiative to Thomas Landauer and Walter Kintsch, a grant from the McDonnell Foundation's *Cognitive Science in Educational Practice* program to W. Kintsch, T. Landauer, & G. Fischer, and an NMSU Dean's small grant to P. Foltz.

The "Intelligent Essay Assessor" has a patent pending: *Methods for Analysis and Evaluation of the Semantic Content of Writing* by P. W. Foltz, D. Laham, T. K. Landauer, W. Kintsch & B. Rehder, held by the University of Colorado.

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Visualizing Navigation in Educational WWW Hypertext by Introducing Partial Order and Hierarchy

Ossi Nykänen
Digital Media Institute / Hypermedia Laboratory
Tampere University of Technology
Finland
ossi.nykanen@cc.tut.fi

Abstract: Building a visual navigation aid system for WWW-based hypertext is difficult due to the implicitly structured nature of associative hypertext. The task can be made significantly easier by identifying and explicitly stating the latent hierarchical and pre-set reading order of hypertext and by reducing the number of relations presented. A simple formalism and a method of constructing a visual graph-based navigation tutoring system for WWW is presented. The work is demonstrated in practice by briefly introducing a visual navigation system prototype, the Navtutor applet, that can be used with existing Web learning materials with little extra work.

Introduction

Today World Wide Web (WWW) is filled with information presented in hypertext format. Thanks to the global identification and retrieval mechanisms of documents and the standard hypertext markup language (HTML), WWW potentially offers means to create well-structured global hypermedia. From the authors' point of view, however, to date the syntax of HTML has not really supported nor been used for, e.g., explicitly defining document categories or linking semantics needed for creating navigation tools visualizing logical contents. This has led developers to search for different types of *ad hoc* solutions for structuring and coding their WWW material.

Structured hypertext is typically captured in a shape of different-looking WWW sites with (picture-based) link lists and overview diagrams similar to the navigation structures proposed in the early 90's (Nielsen, 1994). Systematic use of dynamic, visual graph-based navigation methods has been little, most of the educational navigation systems rely on text-based linking and image map techniques (Turau, 1998). Due to the enormous amount of references, visualizing complex associative linking is generally considered impractical as a navigation metaphor. Educational material is still at largely presented using the book or desktop metaphors which, in effect, provide little basis building structural mental models of the fundamentally non-linear (structured) hypertext. The straightforward use of book metaphor with linked keywords, for instance, adds little to using well-written conventional paper materials. Similarly, target-oriented learning is very difficult if it is simply based on flat associative hypertext. A dynamic, map-based navigation metaphor should help users building concise mental models to construct knowledge of the structure and relations of the hypertext at hand (Preece *et al*, 1994).

Motivation for us finding general solutions for providing students visual graph-based navigation tools arose when developing Web-based learning material for undergraduate-level mathematics (see, e.g., (Pohjolainen *et al*, 1996), (Nykänen & Pohjolainen, 1998) and (Luodeslampi *et al*, 1998)). Simply producing hierarchical, associatively linked WWW pages seemed to fail to achieve the latent potential of using computers to present structured learning material. We felt that in order to make the chosen structure "live", we should effectively promote the use of the fundamentally non-linear yet logical structure of hypertext. We hoped to achieve this by providing students maps to visualize the "expert's" view on the structure of mathematics (within a given course). There already exists case studies and tools of visualizing navigation and searching in (educational) contents (see, e.g., (Chavero *et al*, 1998) and (Akoulchina & Ganascia, 1997)) but our goal was to investigate and design a general WWW-based navigation system to be used in parallel with our prototype of a Web-based open learning environment in the future (Nykänen & Ala-Rantala, 1997).

During the process of structuring our learning material, we learned two major lessons. First, more detailed structure to supporting navigation we hoped to construct, more problems we encountered in practice. The "goodness" of a definition and granularity of hypertext depends on many things since structuring material can be based on a number of perspectives. Historical, purely logical or pedagogical approaches do not necessarily yield to the same structure. The second and the more important observation was, however, that after a guideline general enough for structuring material sufficient for our purposes was found, it was rapidly applicable to number of other subjects, besides mathematics, as well. To us the solution was to identify and clarify the implicit structure of (educational) hypertext. The main idea is to recognize and explicitly state the logical reading order of "key" pages and to cluster them into hierarchical groups.

After finding a simple syntactical way to clarify the essential structure of hypertext, we designed and implemented a simple prototype navigation tutoring system to exploit and test our ideas. Our software prototype, the Navtutor applet, was designed to function in parallel with existing Web clients.

The purpose of this paper is to motivate and present the idea of constructing a visual graph-based navigation tutoring system for WWW, and to suggest means to do this both in theory and in practice.

Introducing Partial Order and Hierarchy to Hypertext

Creating a good general navigation system for HTML-based hypertext is very difficult. The basic linking method using associative linking is extremely general by definition and introduces little structure to base a navigation support system on. In order to construct a general device for aiding navigation, an abstracted reference structure of hypertext is needed. In this chapter we will briefly describe the syntax of a *hierarchical prerequisite graph* (HPG) that is used to model the hierarchical and ordered structure of a given hypertext.

Implicit Structure of (Educational) Hypertext

The obvious method for developing syntax for practical visualizing of hypertext is to try to reduce the number of relations presented. Motivation for this is found from the contemporary WWW hypertext. In practice most of the educational WWW sites implicitly add two types of additional semantic relations to hypertext

1) by grouping individual pages of hypertext into hierarchical clusters, and
2) by introducing a partial reading order between different pages of hypertext.

For example, most WWW sites provide users a front page that divides information into various sections each of which consisting of a number or WWW which include information which is sensible only when read in some appropriate order. Obviously other types of link semantics are used also, including references, notes, examples, etc.

The important notice is that the seemingly arbitrary linking does not essentially reflect the logical structure of the WWW site. From the "definition" of hypertext we know that the structure of hypertext actually predefines the conceptual limits of the associative structure of hypertext by providing users links to follow. Similarly, logical reading order precedes the associative structure of hypertext. This implies that the associative structure of hypertext itself must have a backbone, *a core structure*, which lays down the basic pre-set logical structure of the hypertext. After all, if this wasn't true, the hypertext would actually consist of some sort of an associative database of completely independent records of the same level without any specific reading order(s).

Thus the associative structure of hypertext is associative only from the viewpoint of the users' limited dynamic control, not from the viewpoint of the core structure of hypertext itself. The core structure of hypertext is essentially hierarchical and pre-set. It turns out, that since our goal is to introduce a navigation aid for (educational) hypermedia, this observation is very useful to us.

Hierarchical Prerequisite Graph

Technically HPG is a semantic network consisting of vertices corresponding to each of the pages of hypertext and directed labeled edges defining two types of relations between vertices. These relations, *partial order* and *hierarchical inclusion*, are selected according to the desired logical structure of hypertext and do not necessarily include all the associative relations between the pages of original hypertext nor consist only of them. Figure 1 presents an example of a HPG consisting of nine vertices and fifteen edges or relations between vertices.

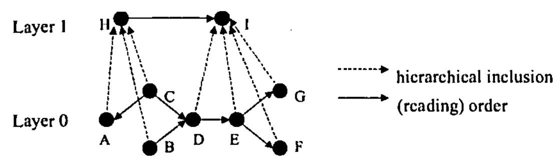


Figure 1: An example of a hierarchical prerequisite graph.

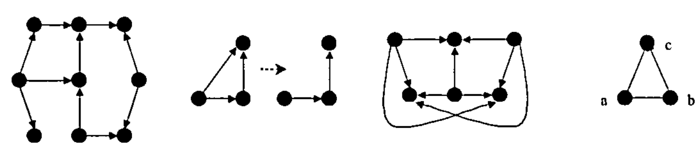
The example should be interpreted as following: the referred hypertext consists of two logical groups of pages, H and I (vertex sets {A,B,C} and {D,E,F,G} on layer 0) that have a definite prerequisite order in which pages are assumed to be read. The pages H and I are also assigned a prerequisite order on layer 1. In practice the example could model, e.g., a hypertext of two "sections" with introductions, each of consisting of number of "topics".

The structure of an HPG is straightforwardly generalized from this by adding more hierarchical layers (for instance in the previous example by further grouping H and I to some group J on layer 2). Relations of HPG are constrained as following: vertices on each layer form a directed acyclic graph (not necessarily connected) according to the order relations. Each vertex on a layer i is connected to exactly one vertex on layer i+1 or to nothing ("top layer") according to the hierarchical inclusion relations. In addition, each layer includes only the minimum number of edges needed to present the order relations which are assumed to be transitive. If the prerequisite structure is consistent, the direction of associative reference links should typically be against the direction of prerequisite links (order relations). Similarly references to concepts of higher or lower levels should refer to different layers (hierarchical relations) of the HPG.

Construction of Hierarchical Prerequisite Graphs

From the formal point of view a HPG can be described as a collection of directed acylic graphs $G=(G_0, G_1, ..., G_i, .. ,G_N)$ where each G_i corresponds to the *prerequisite graph* at layer i (see figure 1). Each graph G_i consists of a set of vertices $V(G_i)$, $V(G) = V(G_0) \cup V(G_1) \cup .. .\cup V(G_N)$, a set of edges $E(G_i)$, $E(G) = E(G_0) \cup E(G_1) \cup ... \cup E(G_N)$, and a set of hierarchical references $H(G_i) \subset V(G_{i+1})$ to layer i+1. For G_N, $H(G_N)=\emptyset$ because the vertices on layer N have no hierarchical parents. Note that an arbitrary G_i is not assumed to be connected. This implies that it may consist of several components; an arbitrary vertex $a \in V(G_i)$ may not be accessible from vertex $b \in V(G_i)$.

Prerequisite graph G_i is simple, i.e., it includes no parallel arcs nor loops. It also agreed that prerequisite semantics define no directed cycles. From the definition of a HPG it also directly follows that for each G_i no vertex is both the start- and endpoint of a directed walk. Graph G_i needs not necessarily to be a rooted tree, however, since it may include more than one root vertices. Figure 2a presents an example of a simple prerequisite graph.



(a) (b) (c) (d)

Figure 2: The structure of a prerequisite graph, an idea of a method for reducing redundant semantic information, non-planar $K_{3,3}$, and clique T_3.

Constructing prerequisite graphs based on a given directed acyclic graph is easy. The prerequisite (order) relation is transitive, which provides a straightforward method of removing semantically redundant edges (see figure 2b). Edges are removed if and only if the accessibility of vertices does not change.

Unfortunately, from the viewpoint of visual presentation of (even small portions of) prerequisite graphs, the given prerequisite graph G_i is not necessarily planar (like the example in the figure 2a), that is, it's sometimes impossible to draw an (isomorphic) 2D presentation of the graph with no crossing edges. Figure 2c demonstrates this with a counter-example of a directed graph $K_{3,3}$. The prerequisite graph has, however, some nice properties that can help parsing clear visual presentations of the graph. For example, it follows from the definition that a prerequisite graph does not include the (directed) clique T_3 (see figure 2d) as a sub-graph. This motivates finding appealing local isomorphic representations of the prerequisite graph.

Formulating Visualizations

Our goal is to provide a visual navigation aid for navigating hypertext that can be modeled using some appropriate HPG. For simplicity, we choose to visualize the given HPG as one layer at a time, by dynamically parsing a *visualization graph* S of a subgraph of the G_i selected.

The main idea to visualize the structure and context of the prerequisite graph is to use *direction metaphor*, our intuitive notion of physical direction, to encode the semantic information. The portion of the G_i to be visualized is drawn on a (bound) 2D surface with the selected vertex in the middle. Adjacent vertices are "grown" in north and south directions, according to the prerequisite relations in G_i. Figure 3a presents an example of a such visualization.

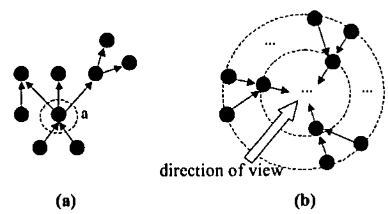


Figure 3: Example of visualizing a subgraph of G_i (selected location vertex a is marked with a dashed circle) and illustration of the direction metaphor

In the example above, the semantic interpretation of the order relation is clear. Vertices prerequisite (and close) to the selected vertex a are positioned south and vertices accessed from a north from a. Because S includes no cliques T_3, crossing edges (if any) will be appear in S only from two vertices away from a given vertex.

Direction and location metaphors try to provide the idea of direction and context for the user by dynamically generating a sequence of visualization graphs during the navigation. Each time a new location vertex is selected, each visualization "points" to the "center" of the given prerequisite graph (see figure 3b). During the navigation, the view "rotates" around the "center" according to the prerequisite relations. The visualization graph also naturally provides graphical encoding for "closeness" by including only vertices "close" to the selected vertex (in the sense of the explicit prerequisite relations).

However, in order to provide user a intuitive method for navigating, further remarks are needed. Merely creating a balanced 2D presentation of G_i would probably just confuse the user: navigation process is typically a sequence of selecting adjacent location vertices that should be visualized in the navigation process as moving to a certain (abstract) direction. Presenting user a sequence of rapidly-changing visualizations will not help developing a mental (structural) model of the relations of the graph because by doing so the visualization would change dramatically during each navigation step. Navigation systems ought not to create a set of independent balanced graphs but to process an animated sequence of dynamic graphs instead.

In practice this suggests that the visualization should be parsed dynamically according to the user's location and navigation history at the hypertext. Formally this is done by defining a *visualization function* v_P which, according to the user's current location in the hypertext and some parameters P, fixes a subgraph of G_i to be visualized as a visualization graph $S=v_P(a)$. When user navigates in the hypertext, visiting nodes a_1, a_2, ...a_j, ..., a_M, that make up the *total navigation history*, the process generates *a sequence of visualization graphs* S_1, S_2, ..., S_j, ..., S_M to be show to the user. Now each S_j is a graphical presentation of selected subgraph of some G_i with fixed relative vertex positions, color coding etc. set in P. Typically S_j would, e.g., include (provide a one-to-one mapping) only the vertices $b_k \in G_i$ such that the distance from b_k to a_j is less than some fixed value, positioned to a plane with descriptive labels, according to some balanced graph drawing algorithm satisfying the idea presented in the figure 3a. Note that the vertices of different visualization graphs need not to belong to the same layer.

Each transition is then visualized by using in-between animation frames from one visualization graph to another. Plane transitions along the "partial order" edges are visualized by moving and transforming S_j to S_{j+1} by moving, hiding and showing appropriate vertices. Vertical transitions along the "hierarchical inclusion" edges are visualized by conventional zoom in and out metaphors.

This scheme can be further developed by making additions to the visualization process. We connect the last step of the total navigation history to the visualization function v_P by exploiting the latest visualization graph S_{j-1} (j>1) which makes it possible to locally optimize the sequence of visualization graphs in order to keep the sequence of visualization graphs as smooth as possible during navigation. This way the user has two fundamentally alternative options for visualizing the navigation process:

1) the user can choose each $S_j=v_P(a_i)$ to be first globally optimized and then presented by using animated in-between frames from S_{j-1} (if possible, that is, $j>1$), or
2) the user can choose each $S_j=v'_P(a_i,S_{j-1})$ to be locally optimized to match S_{j-1} as closely as possible (if possible, that is, $j>1$) and then presented by using animated in-between frames from S_{j-1}.

The two options introduce two different ways of navigating. The former navigation method is *transition invariant* always producing the same visualization $S_j=v_P(a)$ no matter the path the user took to get to a. The latter navigation method, however, is *transition variant*. In this case, the path the user takes to get to the vertex a may cause visualization $S_j=v'_P(a_i,S_{j-1})$ to look different, according to the previous vertex a_{j-1} in the total navigation history. Note that both types of visualizations should be isomorphic to each other; the essential difference between different S's produced is the calculated vertex positions on a plane.

The decision between transition invariant and variant navigation modes is a trade-off between smooth in-between animation and global appearance of visualization graphs. The former provides user intuitive navigation sequences, but can sometimes confuse the user by introducing different layouts for visualizations depending on the navigation history. The latter, on the other hand, forces the visualizations always to look similar, but can sometimes make the in-between transitions to look complicated.

Demonstration: Navtutor Applet

To test the idea of exploiting order and hierarchy information in WWW sites, a prototype navigation support system, Navtutor, was written and tested with our existing WWW-based learning material (see figure 4). Test material consists of our experimental learning material of elementary matrix algebra (in Finnish).

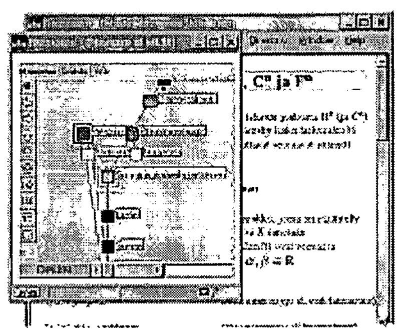


Figure 4: Navtutor window on top of a Netscape browser window.

The basic idea is to describe a educational WWW site in the terms of a HPG description file providing structural data for the Navtutor applet. For demonstration purposes we designed a small "learning structure" for the introduction of a matrix algebra course by defining the prerequisite and hierarchical order in which we thought different concepts should be studied.

The basic navigation is carried out with a standard Web browser. Browser process provides user the basic navigation functionality essentially by fetching and presenting HTML-encoded documents from the WWW, based on the browser's graphical user interface. When stumbled across a WWW site including appropriate Navtutor structural information, the browser process loads and initializes the Navtutor applet and provides it information about the browser windowing system references (in order to display pages at request and notify events) and instructs what hypertext HPG description to use.

The graphical user interface of the Navtutor applet consists of two parts: map view and control toolbars. The map view presents a dynamic visualization of the selected portion of the HPG describing the core structure of the hypertext (see figure 3a). When user selects a vertex, the map view smoothly animates to the selected vertex according to direction metaphor (see figure 3b). In each navigation step the visualization is dynamically parsed to reflect the contextual state of the users "location" in the HPG model. Vertical navigation from HPG layer to another is visualized by zooming in or out from the selected vertex.

In addition to the basic navigation functionality, Navtutor provides also basic methods for more structural navigation by using explicit *navigation modes*. Three modes of navigation are supported: *explore* *mode*, *local mode*, and *target mode*. In the explore mode, the visualization graph is constructed from all of the vertices (pages) "close" to the selected node by using simple breadth-first search. In the local mode, only vertices within the current cluster (hierarchical group) are displayed, and finally, in the target mode, only vertices on a path to a previously selected *target vertex*, are displayed. In practice this means that users are able to limit the information present in the map view to meet their needs when using different navigation (and learning) strategies.

Discussion

Finding a all-round format for describing educational hypertext structure is very difficult. Based on our experiences, designing structures for educational material is hard, but producing (or converting) learning material within the given format can be equally hard, or even harder. As a rule of thumb it would seem, that instead of re-writing existing WWW material, using relatively light additional information structures may turn out to be a "good enough" solution in practice. So far our experiences from Navtutor strongly support this point of view. With very little structuring, most of our educational WWW material should benefit from the single navigation support system implemented.

Of course, one should never apply new methods blindly. At this time of development, we are gathering experiences, based of which our ideas are later revised and systems further developed. One very interesting aspect of the Navtutor software is the interface with our software platform prototype of an open learning environment (see (Nykänen & Ala-Rantala, 1997)).

Finally it should be heavily emphasized that we are not implying that existing navigation systems should be replaced with Navtutor-like applications and thrown away, but rather suggest a parallel and a general alternative for effective and context-based navigation. Empirical research supports the view that map-based navigation aids are at their best when used in together with, e.g., book metaphors, not alone (Leader & Klein, 1996).

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Experience Improving WWW based Courseware through Usability Studies

Vincent P. Wade, Dept. of Computer Science, Trinity College, Dublin 2, Ireland
Mary Lyng, Dept of P & Q, Waterford Institute of Technology, Waterford, Ireland

Abstract: The World Wide Web (WWW) has been heralded as a significant opportunity to deliver successful tele-educational courseware and learning experiences. The central tenant of the WWW being that everyone (educationalists) can become a publisher of educational material. However, although possessing technical or educational skills, WWW user interface design, usability and good pedagogical layout of WWW based content, are skills which are frequently weak amongst many of this community. This paper researches and proposes an easy to use 'usability' criteria and questionnaire, which facilitates the evaluation of educational WWW courseware. The paper describes the implementation of a WWW based server system for the questionnaire. The paper also describes how the system was trialled on an already proven WWW courseware system and still provided indications where improvements could be performed. The paper concludes with an assessment of the benefits of iteratively utilising such a system to improve WWW courseware.

1 Introduction

The last three years has seen a rapid increase in the use of WWW based educational tools, courseware and environments (Wade et al. 98). The applicability of WWW as a medium for educational experiences has been well documented as it's ubiquity of presence, it rendering capability for graphics, text, animation, video and audio, and it's potential for interactivity (both between participant and educational content as well as participant to participant) (Maurer 97), (Turoff 95). However, it is also well accepted that educational technology, over the last thirty years, has failed to achieve the revolutions that were initially forecast (Bates 95). There have been many reasons proposed for the failures of various educational systems, the two most widely reported being (i) the lack of pedagogical support within the educational systems (ii) the difficulties experienced by learners in using such systems. This paper addresses this second most common cause of failure. Usability as defined by the International Standards Organisation (ISO) is the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments. The paper focuses on evaluating the users' satisfaction of working with WWW educational systems and highlights the important issues when addressing the design of WWW courseware.

2 Usability for Educational Systems

This section identifies the users' satisfaction requirements / user interface requirements for WWW courseware which are derived from the pedagogic theory imperatives.

2.1 The Learning Environment

A learning environment must provide the learner with four key requirements (Duchastel 97). These are information, interactivity, structure, and communication. The learning environment must also implement key interface design concepts (Jones et al. 95). These key concepts can be loosely categorised by research facilities, presentation details, integration across various media, appropriate use of tools, and help facilities.

2.2 Layout requirements of a Learning Interface

When planning the layout of the interface, many factors will require consideration.

Engaging the User: The main consideration when deciding upon the layout of a screen is to assist learners in focusing their attention on the key aspects of instructional material while maintaining interest in the overall lesson content and activities. The intent is to draw attention to the relevant lesson content by adopting conventions that draw proportionately more attention to the selected information than the remainder of the lesson (Hannafin et al. 89).

HCI Principles: The interface of the instructional material must adhere to the HCI principles that have emerged through the years (Macauley 95). These are: the interface must be natural for the user to use; the interface must provide user support; the interface must be consistent; the interface must be non redundant; and the interface must be flexible.

There are also two categories of design rule: standards which are high in authority and limited in application, and guidelines which are lower in authority and more general in application.

Interface Structure: The structure of the interface must have at least two areas for the instructional material (Brooks 93). These are a navigation area and a presentation area.

Layout of the instructional material: It is not sufficient to place the information from a previous source on the Web and expect it to work as a presentation (Brooks 93). Many suggestions have been specified over the years about the layout of instructional material. The following suggestions could be considered. The provision of a menu in some guise, which is available at all times (Rambally et al. 87). The location of material of the same type should not vary from one screen to the next (Rovick 85). There should be consistency in the use of backgrounds, fonts, and colour (Brooks 93). Any special effects used and icons should be tested with users first to check their appropriateness (McFarland 95). The document should not be too large for two reasons. It will take longer to download, and not all learners may like scrolling (Nielsen 97). Scrolling can leave a learner disoriented (Berners-Lee 95).

2.3 Presentation of Instructional material components

The components that are required to produce instructional material can be a combination of text, graphics, video images, etc. so many factors require considering. Another issue of concern here is the inclusion of colour.

Textual Material: When deciding on how to present text, there are guidelines that need to be adhered to (Rambally et al. 87). These include: placing key information such as urgent messages and instructions in a prominent and consistent location; standardising the terminology used; establishing prompt-string conventions (captions) in order to provide a systematic, predictable visual correlation between prompts and their corresponding data input fields; and positioning captions in a natural and consistent physical relationship to the corresponding data fields. It has also been suggested that screens are easier to read if the text is structured in natural eye sequences, such as from top to bottom (Hazen 85).

When writing textual educational material, guidelines on how to lay it out should be adhered to (Bailey et al. 91). These include: distinctly separating paragraphs on the screen to promote cohesive groupings; left justifying the body text and ensuring that it is right ragged; ensuring that hyphens are not be used to break words at the end of a line; using sentence case rather than upper case as it speeds up the reading process; using UPPER CASE to draw attention; and using one font consistently, with point size greater than 12.

Non textual material: Interactive graphing, windowing, and animation differentiate the computer as a medium from most other media (Hazen 85). Tables can be used to graphically represent complex relationships (Schlegal 96). Graphics should be used when they contribute to the understanding of the text (McFarland 95). However, considerations of the size of the graphic should be made, as it should be able to fit into the graphical browser's window in order to provide the learner with the whole picture, and note also that a large graphic can take a long time to download. Slow graphics can become tiresome and/or interrupt lesson flow (Hazen 85). The key point with non textual material is not to let available equipment or technology determine the presentation of the instructional material (Brooks 93).

Colour: Colour has some uses when presenting material (Rambally et al. 87). These include: linking logically related data; differentiating between required and optional data; highlighting errors; separating various screen areas such as prompts and commands; emphasising key points; and communicating the overall structure.
When applying colour, the following guidelines have been recommended (Macauley 95): use colour coding consistent with user expectations; similar colours should denote similar meaning; avoid use of extreme colour pairs to avoid frequent refocusing and visual fatigue; adults may need higher brightness levels to distinguish colours; colour blind users must be considered, as they may not be able to distinguish some colour

combinations; use background colours in large blocks; group related elements by using a common background colour; use bright colour for emphasis and weaker colours for background areas; and brightness and saturation draw attention. In relation to WBI, there have been recommendations made (Jones et al. 97). These include: selectable areas should be clearly identified by a royal blue colour; interactivity is apparent by changes in the cursor as the cursor is moved to a hot spot; when a selection is made, the HTML standard is to immediately change to a dark red selection; and to indicate progress made, accessed links become a light red colour. In contrast, another view held on the colour of visited links is that they should signal the fact they are "exhausted" by being a darker colour than non-visited links (Kirsanov 97).

3 Evaluation Criteria and Implementing WWW based usability evaluation system.

The objective of the evaluation was to evaluate whether the present learning environment's user interface is conducive to learning, i.e. measure the users' satisfaction in terms of the their experience with the system. In order to carry out this evaluation, goals had to be specified but goals on their own are not measurable. Therefore from these goals, objectives were derived (Mandel 97). The concentration of the evaluation was on subjective measures rather on performance measures because it was required to address particular aspects of the system performance and thus required focusing on certain tasks (Whitefield et al. 91). The goals and resultant criteria reflected the performance levels required from the system from a learner viewpoint. These included the aesthetic appeal, ease of reading, ease of navigation, and the effort required reading through the material and navigating through the system. The goals are shown at HREF 1, and resulting evaluation criteria are shown at HREF 2.

The goals and resulting criteria produced a long list of items, which it was felt would be too detailed for a questionnaire. It was decided to structure the questionnaire into five sections, one for each of the HCI principles. The items from the evaluation criteria were examined and placed into one of the sections. Not all evaluation criteria were explicitly included in the questionnaire as some items were combined with other items or were deemed to have been redundant. The questionnaire is shown at HREF 3.

The questionnaire was placed on the Web so that the user could fill it in during the evaluation. Therefore, the design of the questionnaire involved producing five web pages, one for each HCI principle. There was a statement given for each question, and the User was asked to respond to each statement by choosing a point from 1 to 5 which determines whether they Strongly disagreed, Disagreed, Strongly agreed, Agreed or were Neutral with the statement. It was decided to read in the questions dynamically when the HTML file was being published rather than specify the questions in the HTML file. This ensures that any changes that are to be made to the questions only require a change to the text file of questions rather than a change to the HTML file. In order to provide this facility, an HTML file is not adequate, so a Common Gateway Interface (CGI) program written in PERL was used. The program opens and reads the entire contents of the text file of questionnaire statements and places them into an array. For each element of the array, it is displayed as a statement followed by the five radio buttons representing the five possible responses. When all elements of the array have been displayed, the User is then requested to Send or Clear the data. The second PERL program elicits the responses and stores them in text file separated by tabs. This procedure is described in Fig 1.

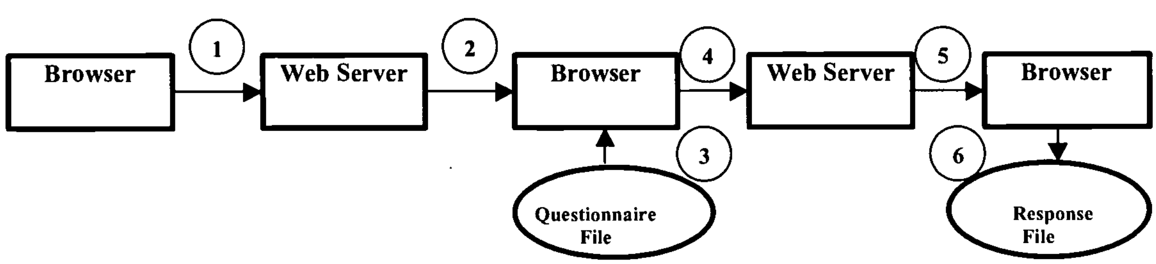

Figure 1: WWW questionnaire procedure

1. Browser requests CGI program from web server.
2. Web server recognises CGI request and initiates the CGI program.

3. CGI program reads questions from questionnaire file and displays the questions, and requests responses from the participant.
4. CGI program requests access to another CGI Program for data processing.
5. Web server recognises CGI request and initiates the CGI program.
6. CGI program transfers responses to Data file.

When the questionnaires are filled in, programs that can be run on the Web make an assessment of the responses. In order to produce any feedback/results from the evaluation, five programs were designed to produce five Web pages of results. In each program, the file of responses for the respective HCI principle is opened, read and processed. Processing of the file involves accumulating the number of times a response value (1 .. 5) was chosen by a participant in the evaluation. Then for each question pertaining to this HCI principle, the question is displayed and the accumulated values are displayed as percentages in a table. When all questions have been displayed, the overall accumulated values for each possible response is displayed. Also, an overall assessment is made which determines if 70% or more Agree or Strongly Agree with all statements then it is very satisfactory. If 50% or more Agree or Strongly Agree with all statements then it is satisfactory. If 70% or more Disagree or Strongly Disagree with all statements then it is very unsatisfactory. If 50% or more Disagree or Strongly Disagree with all statements then it is unsatisfactory. This procedure is described in Fig 2.

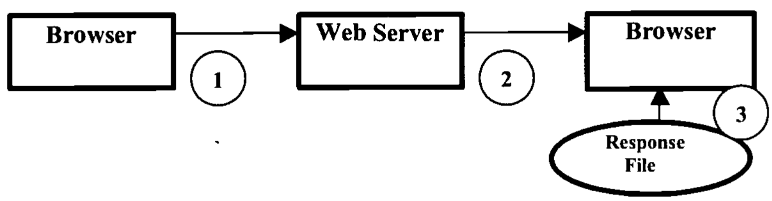

Figure 2: WWW evaluation results procedure

1. Browser requests CGI program from web server.
2. Web server recognises CGI request and initiates the CGI program.
3. CGI program reads responses from Response file, processes the responses and produces an assessment of results.

4 Case Study – Improving RDBMS Courseware

There is a WWW based self learning course, which has been designed and implemented successfully in Trinity College, Dublin. A subsection of the course was chosen and used to test and validate this evaluation. The modules chosen were the modules pertaining to the Select statement, which is one of SQL's data manipulation statements.

The participants for the evaluation were fourteen fourth year students on the BSc in Commercial Software Development, in Waterford Institute of Technology.

The feedback on the users' satisfaction of the RDBMS course produced some positive and negative comments.

Naturalness: The questions that provided negative feedback were concerned with colour and scrolling. Examples of some of the points made with regards to colour included that highlighted words and link items have the same colour, which is confusing; and that words are highlighted using different colours. Scrolling is a facility that cannot be avoided on the Web, however too much of it can irritate users. The participants felt that the material was too far indented and so the user had to scroll across the screen to read the material as well as scroll downwards. Another point made was that spelling errors exist and some words are joined together in the instructional material. Positive comments were also given which included that the instructional material provided was very clear to read and understand, and the instructions identified and described each icon sufficiently.

User Support: The first question about error messages provided some negative feedback but one of reasons for this was there were no errors incurred by the participants. The other area where there was some negative feedback was on the examples used. There needs to be more examples and exercises provided for the

User. Other points noted were that the instructions provided were clear and well presented, and that the Bookmarking and Notetaking facility was a good idea, but when a bookmark is recorded, some feedback should be provided to let the User know that it is actually recorded. Another interesting point made was that a forward button should be included as well as a back button. The main reason for this comment was that the participants felt that when you got to the end of a module, it was not easy to know where to go next. Some used the back button to go to the Roadmap menu; others used the Main menu button and then proceeded to the Roadmap menu.

Consistency: The responses were positive except for the question on error messages. The same reason as above can be concluded for this response. The main comments provided were that there was an inconsistent use of sentence case, italics, spacing and colour.

Non Redundancy : The responses were positive. However, the main concern of the participants was the repetition of the menu throughout the instructional material as well as providing it in the left frame. It was felt that the menu provided in the left frame would be sufficient on its own.

Flexibility: Again the responses were positive. The comments provided included the reference to proceeding from a module to the roadmap, which it was felt was not very clear.

4.1 Changes indicated and implemented

After reviewing the questionnaire results and interviewing the participants, the evaluation identified some changes to improve the users' satisfaction of the courseware, which were implemented. These included the following:

1. The colour of links, active links and visited links were changed to differentiate them from text. A consistent colour was chosen used to highlight words, which is also different than the link colours used. The background colour of the left frame is different to the colour of the right frame so it provides a contrast.
2. Scrolling across the screen was eliminated.
3. More examples and dynamic exercises are included.
4. Spelling errors were eliminated. Consistency in the use of italics, sentence case, and spacing is ensured.
5. The provision of menu items with the instructional material was eliminated, as it is confusing for the User.
6. In the left frame, a link back to the Roadmap menu is provided to allow the User to choose their next module.
7. The left frame was reduced in size to increase the size of instructional material presentation frame.
8. A check is made to ensure that when the learner attempts to bookmark a page that it is not bookmarked already, and when a page is successfully bookmarked a message is displayed informing the learner. The information displayed in the Bookmark window informs the learner of the Module and Page titles stored.
9. A status bar message is displayed each time the mouse moves over a link to clarify for the learner what the link is for.

A second trial using the modified courseware was conducted recently and early analysis of the results indicate an improvement of all five sections.

5 Conclusions and Summary

The use of such an evaluation system is a vital component in the delivery of successful WWW courseware, and may be as important as courseware authoring tools and communication tools. The criteria and questionnaire provide an explicit, easy to use method of evaluating users' satisfaction for educational systems.

The WWW based implementation provides three important features:

1. It greatly reduces the overhead in processing the evaluation.
2. It provides semi automatic assessment of the study results. E.g. if 70% or more Agree or Strongly Agree with all statements for a particular HCI principle then the adherence to that principle is very satisfactory.
3. It promotes and encourages learner feedback and evaluation as it greatly reduces their effort in completing the questionnaire. The system also provides its learners with the results of their efforts.

The overall user satisfaction was enhanced.

6 References

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SCOPE: An Environment for Continuous Improvement Teams in Virtual Corporations

Yongwu Miao, Hans-Rüdiger Pfister, Martin Wessner & Jörg M. Haake
GMD - German National Research Center for Information Technology
Integrated Publication and Information Systems Institute (IPSI)
Dolivostr. 15, D-64293 Darmstadt, Germany
E-Mail: {miao, pfister, wessner, haake}@darmstadt.gmd.de

Abstract: A continuous improvement team is a group of people who work together on the same project and are committed to continuous improvement of their work processes. In order to support continuous improvement teams in a virtual corporation, a comprehensive system is needed to support integrated collaborative work and collaborative learning processes. In this paper, the SCOPE system is presented, which provides support for the definition, modification and execution of session-based collaborative processes for continuous improvement teams.

1 Introduction

A virtual corporation is a temporary network of independent operating units such as creative designers, manufacturers, suppliers, customers, and other experts in marketing and finance linked by interactive multimedia networks to share skills, production facilities, resources, to decrease costs and to increase access to each other's markets. In virtual corporations, the definition of a task is continually changing, and its product is a so-called virtual product that adapts in real time to the customer's changing needs [Davidow & Malone 93]. Excelling in a dynamic business environment requires more common understanding and agreement among team members than individuals' expertise and experience provides. In the life cycle of a virtual corporation, cross-functional teams need to continually expand their capacity to improve their work, processes, relationships and environment. Such a team, called a continuous improvement team (CIT), is a group of people who work together on the same project or who come together to solve a common problem, and are committed to continuously improve the processes on which they depend to get their work done [Hutchings et al. 93].

In order to support CITs in virtual corporations, a comprehensive environment is needed to overcome the barriers of physical separation and to support integrated collaborative work and collaborative learning processes. Existing learning support systems are designed according to one of three metaphors: session, process and place. Systems that rely on a sole metaphor provide insufficient support for continuous improvement processes [Hutchings et al. 93]. In addition, most collaborative learning support systems are separate from collaborative work support environments. In this paper, we present our approach to support an integrated collaborative learning and collaborative work process. The prototype system, session-based collaborative process-centered environment (SCOPE) integrates process support technologies into a collaborative support environment. A *session* is defined as follows: in a period of time activities are performed by multiple actors with different roles in a shared information space to achieve an elementary goal. A *session-based collaborative process* (SCP) denotes a process that consists of a set of coordinated sessions [Miao & Haake 98a]. SCOPE provides support for the specification, modification, and execution of session-based, integrated collaborative work and collaborative learning.

The remainder of this paper is organized as follows: In the next section, characteristics of continuous improvement processes and major requirements are identified. Section 3 presents related work. Section 4 describes how SCOPE supports continuous improvement processes. Finally, we present our conclusions and future work.

2 Requirements for the Support of Continuous Improvement Teams

In order to identify the characteristics of continuous improvement processes and the major requirements of the support system, a scenario in a virtual corporation is developed, which is based on a real scenario presented in

[Hutchings et al. 93].

2.1 A Scenario

Seven members of a team in a virtual software corporation are responsible for designing a software product. The team consists of software engineers and requirement analysts who are geographically distributed. The team wishes to learn how to perform continuous improvement. The team and software process consultants jointly determine what is needed to improve the team's capabilities. Then, training consultants design a training course for the team. They create and customize necessary materials. Such a course takes into account the team's total work situation, team's present job tasks and their social environment. The training course consists of a series of sessions. The sessions take place in working hours and are conducted in the same environment as collaborative work. In the first lecture session, the team learns sound decision-making strategies and principles. After the lecture, the team practices separately in two groups (function design group and interface design group) and sets up the strategies for how they would like to make group decisions. Then, they switch to their collaborative work processes and follow the strategies to make decision for their design. During work processes, the data collected and practice results achieved will be transferred into collaborative learning processes as parts of materials of the following sessions. In the succeeding learning session, the teacher guides the team to analyze and evaluate the currently used decision-making strategies. After that, the team will learn and try to improve their decision-making strategies and use the improved strategies to get their work done. That is, collaborative learning and collaborative work in virtual corporations form a process in which the team as a whole continuously reflects upon events, gains knowledge about job tasks and work processes, improves product quality and work processes, and discovers their learning needs in the workplace - continuously.

2.2 Characteristics of Continuous Improvement Processes

Based on an analysis of the scenario described in the previous sub-section and a reference of design principles presented in [Hutchings et al. 93], the characteristics of continuous improvement processes can be identified.

- *Modularity for flexibility*: Information and materials used and produced in learning activities or working activities are documented as modules. They are constructed as typed and self-contained units of information -- artifacts. Modularized, structured artifact models are beneficial for the team's common understanding and communication.
- *Team-based collaborative learning and collaborative work activities*: Interventions are delivered in team sessions, and emphasize collaboration and shared responsibility. Sessions are designed for team members to gain new skills and knowledge together. In addition, team members collaboratively perform job tasks also in sessions. Team members may adapt or improve collaboration strategies to conduct sessions according to their learning.
- *Phased delivery*: Interventions are phased in their delivery over time. Intervals between learning sessions provide opportunities for the team to apply learning in work. The data collected and test results achieved in working sessions will be transferred to the succeeding learning session. Team members have to schedule an integrated collaborative learning and collaborative work plan to help communication, understanding, and coordination among team members. There are dependencies among sessions, such as temporal sequencing, as well as among participants and artifacts.
- *"Just-in-time" effort*: Learning and its application occur almost simultaneously. In a virtual corporation, the external environment and customer demands are dynamic and changeable. In turn, team's business goals and needs related to a team's mission should be adapted to the changing environment.

2.3 Major Requirements

In order to design an integrated computer-supported environment, according to the analysis of characteristics, the major requirements are identified as follows:

(R1) *Support for dealing with artifacts*: The artifacts are modularized and structured, and should be adjusted and tailored dynamically according to the team's progress.

(R2) *Support for session activities*: The system should support team members with different roles to perform collaborative activities in a shared information space. In addition, the system should provide facilities for team members to define and modify collaboration protocols, a computational description of a collaboration policy or co-decision strategy.

(R3) *Support for definition and execution of SCPs*: A SCP model is a computational description of a project plan or a curriculum. The system should enable team members to define process models. It is desirable that process models can be used to coordinate group work and learning activities automatically.
(R4) *Support for dynamical and collaborative change of process models by teams*: The system should support team members to modify SCPs on the fly. Instead of a single-user process modeling tool, the modeling tool should be able to be used jointly by teams.

3 Related Work

In this section, we investigate existing systems in two aspects, system development and integrated collaborative work and collaborative learning support environments.

3.1 Development Approaches of Learning Systems

Most existing learning systems or environments are based on one of three metaphors: *session, process and place.*

Session-based systems support team members to collaborate within single sessions or meetings. They provide an environment for sharing information and performing collaborative activities at the same time. These systems, such as Microsoft NetMeeting [http://www.microsoft.com/netmeeting], provide support for dealing with artifacts (R1) and for session activities (R2), but have no support for the remaining requirements.

Process-based systems provide support for structuring stages according to the content structure in a overall learning process. Learners can progress at different speeds in the learning process. These systems focus on individual learning. Obviously, these systems have no sufficient facilities to support session activities (R2).

Place-based systems provide virtual places to hold meetings or to perform activities asynchronously. All of the artifacts produced in meetings or individually are left in the places to be reused in the succeeding activities. However, the sequencing of activities performed in places and the transferring of artifacts has to be done manually. A lot of place-based learning systems have been developed recently, such as Virtual Places [http://www.virtualplaces.com], CSILE [Scardamalia et al. 94], VITAL [Pfister et al. 98]. These systems also provide support for dealing with artifacts (R1) and for session activities (R2). However, they can not meet the requirements related to support for SCPs (R3 and R4).

Mixed approach: Some information sharing systems (session-based systems and place-based systems) add means for embedding the group's overall work process into a general collaborative learning environment. For example, CLARE [Wan & Johnson 94] is developed based on a model of three-phase collaborative learning processes. The process can be regarded as a SCP to some extent. However, it offers no support for dynamical and collaborative change of SCPs (R4), because it supports a fixed, domain-specific process model.

3.2 Integrated Collaborative Work and Collaborative Learning Support Environment

Most collaborative learning support systems can not support learning in work settings. They normally support open-enrollment styles of training which focus on improving individuals. Learners may successfully gain knowledge in courses and then they will apply their learning at different places. Such courses rarely take into account learners' present job tasks and their social environment. Some systems can be used to support both collaborative learning and collaborative work separately, because they only provide general communication support. However, to the best of the authors' knowledge, no system can support learners to define and modify a computational description of their work processes as learning practices, and to coordinate their collaborative work by using the computational description of their work processes. No system can support automatically transferring the data collected and the practice results achieved in work processes into learning processes as part of learning materials.

4 The SCOPE System

In this section we present our approach to support CITs. This approach can be characterized by

- using hypermedia to represent artifacts in a flexible way,
- providing shared hypermedia workspaces for sessions,
- using hypertext structures to specify and modify organizational structure, collaboration protocols, and SCPs,

- facilitating the execution of SCPs and collaboration protocols.

This approach has been tested in the SCOPE system [Miao & Haake 98a]. Next, we discuss how to support the specification of SCPs. Then support for continuous improvement processes at run time is presented.

4.1 Specification of SCPs

In this sub-section, we present our approach to specify SCPs. We discuss how to specify sessions first and then present how to specify a SCP.

4.1.1 Specification of a Session

In SCOPE, a session is created for a CIT to learn or perform job tasks collaboratively. In a session, the common information space is potentially accessible by all team members involved in this session. Team members can perform operations synchronously or asynchronously to construct shared artifacts together, and to perform actions to change the state of collaboration. It is important to notice that a CIT consists of members who may have different privileges and responsibilities to deal with artifacts and to coordinate their efforts. To define a new session, team members are required to set values of attributes for the session. Without being exhaustive these attributes include: session name, session type, session creator, session description, collaborative mode, artifact models, collaboration protocol, mapping from organizational to functional roles, scheduled start and end times, etc. Some attributes used in specifying a session are defined by using specific tools: organizational structure definition tool, artifact definition tool, and collaboration protocol definition tool.

Definition of members and teams: Members and teams are defined by using the organizational structure definition tool. With this tool, a member, an organizational-role or an organizational-unit is represented as a node with a type, a unique name and a set of attributes to describe properties. The typed links are represented as direct arrows between suitable nodes. A description of an organizational structure is represented as a Directed Acyclic Graph.

Definition of the artifact model: An artifact model is defined in terms of task-specific typed hypertext objects (nodes and links) together with operations on them to support a certain activity [Streitz et al. 89][Wang & Haake 97]. Artifacts are organized into these node and link types according to their structure, function, and behavior properties. An artifact may be hierarchically structured, and the structure of aggregated artifacts can be defined in an artifact definition tool, which is a part of the COWFISH system [Wang & Haake 97].

Definition of collaboration protocols: A collaboration protocol is described like a state-transition diagram where a node may contain a sub diagram describing the state represented by that node in more detail. A state node in a diagram represents a state within the collaboration protocol. A link in a diagram represents an event. The occurrence of an event causes a transition between the two states connected by the link. Each state of the collaboration is associated with a set of behavior rules. A behavior rule specifies which roles are permitted to perform which operation on what type of artifacts. A link is associated with a behavior rule or a logical expression. The detailed description of collaboration protocols is presented in [Miao & Haake 98b].

4.1.2 Specification of SCPs

Every SCP is represented by its description, which is called a process model. This description specifies all sessions embedded in the process and the relationships among these sessions. SCOPE provides a visual process model language for process definition. A process model is described as a hypertext document consisting of nodes that are connected via links. A process can be decomposed into sub-processes. The components and the structure of a (sub)process are described inside the (sub)process node. Session nodes, the elements of processes, are specified in the way described above.

The process models are specified in SCOPE by using the process definition tool (see Fig. 1). The tool shows a window title bar listing the name of the overall process model and the tool type. Below that is a list of icons showing the current users of the tool, followed by a button bar with generic functions for editing, navigating hypertext documents, and specific functions for editing process models, followed by a palette of components of the visual process model language (left side) and the content pane (right side) displaying a process model. In Fig. 1, an example of a process model is presented, which describes the collaborative learning process explained in the scenario (see Chapter 2.1). This part of process model consists of a session for collaboratively customizing materials, a lecture, two practice sessions, and a workshop. They are connected by temporal links, such as "finish-trigger" and "AND-split", and by artifact links with named artifact buffers. It is important to note that the artifact input/output buffers are used to exchange artifacts across (sub)processes. For example, in practice sessions, decision-making strategies are defined as collaboration protocols that will be transferred to the collaborative work process. The defined collaboration protocols will be initiated in groups' collaborative work sessions, and guide and control group decision-making processes for design. The feedback from the collaborative work process will be imported into the workshop via an artifact-input node. After a process model is defined, it can be stored in a process model base and can be instantiated and reused. Next, we will discuss the run-time features of SCOPE.

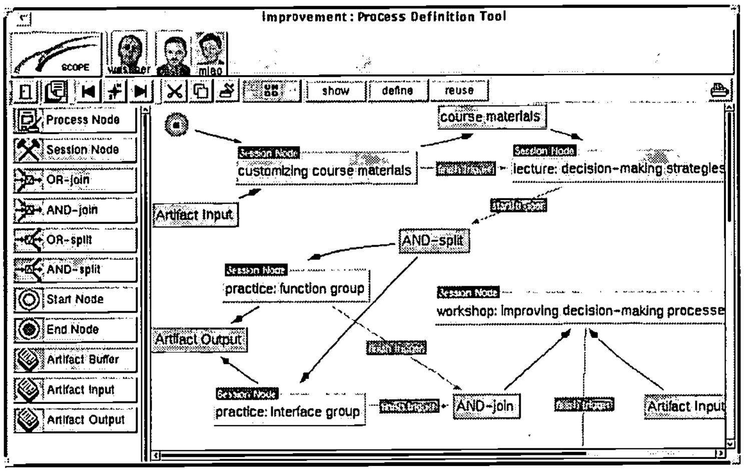

Figure 1: An example of a process model

4.2 Support for Continuous Improvement Processes at Run Time

Process execution is concerned with the enactment of a process following the previously defined process model. Now, we discuss process execution from the users' perspective.

Team members can select a pre-defined process model from the process model base as their initial process model. If no suitable process model exists, they can define a new one. When they start to execute the process model, an instance of this process model is created. This process instance will progress according to its process model.

Support for execution of session activities: Each team member has a personal information panel. In this panel, information is listed about processes and sessions in which he/she should be involved. He/she can join a session by selecting it from the session list. When he/she joins a session, the top-level of the shared information space of the session is displayed in the session browser and he/she can browse through the artifacts following the recorded dependencies. In this browser there is a palette that lists the artifact types, which are allowed to be created in the current state according to the rules defined in the collaboration protocol of this session. The shared artifacts can be viewed and edited simultaneously by team members working in the session depending on their access rights. When a user performs an operation on an artifact, the system will check whether this member has the access right to execute the operation according to rules defined at this state of collaboration. If the check is successful, the change will be propagated to all sites. To maintain consistency for concurrent changes at different sites, a fully replicated concurrency control mechanism is provided by COAST [Schuckmann et al. 96]. Transitions from one state of collaboration to another may be carried out by team members who have the right to perform actions. Allowed actions are also listed in a palette in the session browser. Each session has an autonomous agent that monitors the status of collaboration periodically by evaluating the transition conditions. If a condition is met, the system changes the state according to the collaboration protocol.

Support for execution of SCPs: Changes of the state of collaboration in one session may result in changes of the state of related sessions according to the process model. In the case of two sessions connected by a "finish-trigger" link, once the source session is finished, the state of the destination session will change. In SCPs, artifacts will be automatically transferred between sessions according to the process model.

Support for dynamical change of SCPs: Even when a process instance has already been created, parts of the process model can be modified. That is, the values of attributes of the related sessions can be modified and the model of a sub-process can be altered.

5 Conclusions and Future Work

In this paper, we described the major requirements for supporting CITs in virtual corporations. Based on the concept of session-based collaborative processes, we developed a modeling methodology and an environment, SCOPE. The system can support definition and execution of session-based collaborative processes. This is realized by maintaining shared hypermedia workspaces with the aid of data level control mechanisms, such as access control and fully replicated concurrency control, and user level control mechanisms, such as collaboration protocols and SCP models. In addition, the SCOPE system provides a high level of flexibility for team members to adapt artifact models and to modify process models at run time. By using the facilities provided in the SCOPE, members of continuous improvement teams can define and execute integrated collaborative work and collaborative learning processes. They can improve their work processes through applying their learning and identify learning issues at work to fit the changes inside and outside of virtual corporations.

SCOPE is a prototype system of our ongoing research project and is currently being tested in our group. Most of our work to date has been focused on demonstrating the feasibility of implementing and using the system. We will develop more collaborative tools required by software development and total quality management. We will further test and evaluate the usefulness of the system in more real-world settings.

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Designing a Distance Curriculum to Harness the Potential of Asynchronous Computer Conferencing: an Example from a Masters Programme in Continuing Professional Development (CPD).

Gillian Jordan, School of Health, University of Greenwich, London, UK
G.G.Jordan@Greenwich.ac.uk

Malcolm Ryan, School of P.C.E.T., University of Greenwich, London UK
M.Ryan@Greenwich.ac.uk

Abstract: There are many reasons why an adult may choose to undertake a distance programme and in recent years there has been considerable interest in off-campus learning and an increase in the availability of such opportunities. The University of Greenwich (UK), a long time provider of distance learning opportunities, is offering, through its School of Health in the Faculty of Human Sciences, an MSc. in Continuing Professional Development (CPD) for health professionals. Computer Mediated Communication (CMC) is at the core of the curriculum process in which off-line, asynchronous conferencing ensures participants have opportunities for critical evaluation and reflection before formulating and sending considered responses. This paper considers elements of the curriculum design in order to reveal the extent to which the embedding of communications technology has provided a unique teaching and learning experience. It will demonstrate how a multi-disciplinary group of health professionals are working collaboratively at a distance, through computer conferencing, to enhance both individual and professional development.

Introduction

The use of communications technology clearly has enormous potential in a number of educational areas; some of these are already being realised and many others are in the process of development. Communications technologies embrace an extremely wide range of resources, from simple e-mail to sophisticated multi-media applications. In this paper we discuss the use of relatively low-level technology, asynchronous computer conferencing, as a delivery and support tool for health professionals participating in a MSc. in Continuing Professional Development (CPD).

The Concept of CMC

Computer Mediated Communication (CMC) is not a new concept nor does it need to use state of the art technology. Whilst some research has been undertaken into the medium, much still remains to be discovered and understood about its impact on teaching and learning. Until this knowledge is available it will not be possible to exploit the technology fully. At the University of Greenwich we run several courses using CMC and are now in a position to begin an evaluation of its potential. In particular we can begin an analysis of its effectiveness as a curriculum tool in the delivery of the MSc. CPD (Health).

We define CMC as, *"the use of computers, telephone lines and specialist software to facilitate interaction between students and tutors irrespective of geographical location or time zone"* (Ryan, 1997). It is this interaction which we consider one of the key aspects of CMC because, *"where opportunities exist for interaction in learning situations at a distance, it helps learners to make leaps in their understanding that are unlikely to occur when working in isolation"*. (Owusu-Sekyere & Branch, 1996)

Synchronous Versus Asynchronous Systems

There is no doubt that modern, synchronous communications systems such as Video Conferencing and Internet Relay Chat are both attractive and powerful but produce technology-driven environments which are in a constant state of flux. They also require participants to be available at the same time, albeit in different places, in order to interact and collaborate. Such 'real-time' technologies are time-location dependent and whilst their appeal can not be denied there is evidence to suggest that asynchronous technologies are better able to facilitate the reflective models (Mason & Kaye, 1990) embraced by many CPD programmes.

Computer conferencing which uses asynchronous media is time-location independent and provides greater flexibility and student autonomy (Harasim, 1989). This asynchronicity facilitates a spirit of co-operative enquiry (Heron, 1985) leading to active dialogue through which participants share ideas and information (Gundry, 1992). The resultant peer-to-peer collaborative interactions have been shown to increase learner satisfaction (Kaye 1992) and involvement in the development of theories of professionalism and professional practice (Richardson, 1993). Our experience indicates that this asynchronous CMC environment provides real opportunities for collaborative and multi-disciplinary discussion, brainstorming, problem solving and networking, which we hope to demonstrate in this paper.

Many adult distance learners engaged in CPD programmes are known to study at home and accessing the Internet would normally require them to subscribe to a commercial service. To benefit fully from time-location independence, students should not be required to work synchronously and in the current financial climate they should not have to bear the additional costs incurred by working on-line or paying subscriptions to Internet providers.

The Context of the MSc. in CPD

The context of this development is a MSc. in CPD for health professionals. Although presently being delivered to health professionals it is the conviction of the course developers that the model itself is generic and has the potential to be transferred to other professions and groups.

Distance learning had to be the mode of delivery for this MSc. so that the potential participants, identified through market research and enquiry, would be able to access the appropriate learning opportunities they needed. It was clear from the start of the development that the curriculum model selected would have to offer much more than that available on a traditional paper-based distance learning programme where even the production of learning materials can take many months or years. This would be inappropriate for a topic as dynamic and diverse as CPD.

The development team holds a strong philosophy that professionals, such as the ones for whom the programme was developed, have much to offer their fellow students from their previous learning and experience. Learning processes selected for the programme would have to acknowledge and make the most of this knowledge, *"the richest resources for learning lie in the adult learners themselves"*. (Knowles, 1990). Thus it was decided to utilise a computer-mediated communication technology which would facilitate the realisation of the potential each student had as a learning resource.

Everyone in a multi-professional group of students would be, at different times, colleague, peer, learner and expert and it was considered that significant deep-level learning could result from the discussion, conversation, debate and argument between these groups which CMC would facilitate. For the students to see themselves, as important and crucial resources would not only ensure that the content and context of every unit would be relevant for each and every participant but also that the group process that would be fostered would result in an atmosphere of collaboration and co-operation. We think we are achieving this; - one student recently wrote in a conference area *"...may we continue to bounce our ideas off each other like light and reflect images in a mirror or window in our world in our efforts to illuminate the subject from all angles"*.

The Concept of CPD

The issue of continuing professional development is of major importance in many professions, including the health professions where evidence of ongoing participation in continuing professional development (CPD) activities is likely to become a requirement for re-registration to practice. CPD is an umbrella term for a wide range of activities relating to professional competence, some practice or clinically based and occurring in the workplace and others more academically based and initiated and run in Higher Education Institutions (HEIs). Methods of assessing CPD activity are also diverse and it is clear that the evaluation of the relevance and quality of an individual's CPD is not an easy task. However, that CPD should occur is not in doubt as maintenance of professional competence is essential for the protection of the public. Grant (1994) suggests that professional knowledge has a half-life of five years and that obsolescence will occur if no new knowledge is assimilated and incorporated into practice within that time.

In the present climate of economic constraint, in the UK National Health Service in particular, it has become increasingly difficult in terms of both finance and study time for many health professionals to fulfil their CPD requirements. We are in a situation, in which health professionals must have evidence of CPD to maintain a licence to practice but at a time when they are finding it more and more difficult to participate in suitable CPD activity. It is in this context that the MSc. in Continuing Professional Development (Health) (Collaborative Learning through Reflective Practice and Computer Mediated Communication) was conceived and developed.

The programme is now in its third year and has three cohorts of students. They represent almost all the health professions and encompass a wide geographic spectrum including Austria, Canada, Cyprus, Malaysia, Malta, New Zealand, South Africa and the UK.

The Choice of a CMC System - Why Lotus Notes?

Having decided to use asynchronous, text based computer conferencing on the basis of its fitness for purpose (Laurillard, 1993) the software chosen was the groupware product Lotus Notes. Groupware is essentially any computer application that runs over a network, and/or is accessed by direct dial means, allowing the user group to increase their communication, collaboration, and co-ordination. Lotus Notes is currently the only software on the market that captures these processes in one product, with the potential for customisation.

The immediate advantages of Notes appeared to be its availability on multiple platforms in both server and client forms. It is an industry-standard package with a massive international user-base providing sophisticated E-mail and conferencing facilities. We felt it would appeal to novice users of communications technologies but with infinite possibilities for expansion and development. It was supplied with a number of templates that were customisable to enable the development of a range of databases to support conferencing and workflow applications. Unlike many of its competitors, Notes allows off-line working with replicas of conferences and mailboxes using a remote, direct dial facility with the option of networking and connectivity via TCP/IP.

It was perhaps this apparent ease of use, the attractiveness of the interface and the facility to work completely off-line that appealed most. In this paper it is not our intention to promote a particular brand of software but to examine the concept and impact of CMC on distance learning. What we have experienced whilst using our chosen product may be replicable with other software.

Unique Features of CMC Supported Learning

In developing a CMC system we began by trying to reproduce our experiences of classroom-based teaching but soon realised that computer conferencing impacts on the dynamics of the group and changes the nature of face-to-face (F2F) activities. Additionally, we discovered that communications technologies provide some unique opportunities for interaction which should be exploited (Anderson, 1996).

Ongoing evaluation has revealed that students appreciate the opportunity to be able to ask for and receive almost immediate support from tutors. They welcome the interactive and collaborative nature of the environment, get to know their peers and tutors as recognisable personalities despite the absence of non-verbal cues. They comment on feeling as if they are actually attending the institution (virtually) and make reference to being part of a community. This twenty four-hour access to the learning community and the automatic archiving of all discussion, a feature of the software, produces two highly valued resources. These two features alone establish a novel identity for CMC supported distance education in that neither aspect is normally available in traditional F2F or distance models of learning. (Ryan, 1997)

As indicated by the literature, we found the asynchronous and archived exchanges between participants aid the reflective process and students gain considerably from access to a team of staff who are able to provide different perspectives on issues and problems. Team-teaching, long since abandoned in f2f classrooms, becomes a financially viable method of delivery by CMC. This virtual environment appears to provide more opportunities for students to determine the pace, direction and focus of discussions, which results in a more learner-centred approach to the curriculum. Based upon what has been learnt we have now developed a customised Notes desktop with databases that combine together to give the impression of a virtual integrated learning environment (Ryan and Culwick, 1997). Our experience of using CMC has raised a number of questions and identified several issues for curriculum developers and learning technologists. Of significance is the undoubted impact that using CMC has on teaching and learning.

Impact on Learning and Teaching

The themes of the MSc. in CPD (Health) are collaborative learning, reflective practice, critical thinking and research. They are explored in each of the five units of the programme, which are followed sequentially. Each cohort of students stay together throughout the programme and Accreditation of Prior Learning (APL) is not used to provide exemptions from any part of the programme. Although this might indicate a less flexible approach, it is an essential element that supports our philosophy. The responsibilities inherent in being a member of an active group enhance the sharing of individual experiences and perspectives for the benefit of the group as a whole, *"...individual learning as part of a group process"* (Kaye, 1992). The flexibility arises from the asynchronous nature of the programme, giving the participants opportunities to connect to the system at any time of day or night from anywhere in the world, and being able to study off-line, without the pressures associated with on-line working.

Collaborative Learning

Professional development does not occur in isolation but through collaborative learning and working. Within a health profession environment it is essential that participants learn about each other's professions and are helped to develop inter-professional working practices. One student described how this approach was appropriate for her, *"I have always held near to my heart the potential that peer-to-peer collaboration has for individual and multi-professional CPD."*

The UK Government (1997) has clearly articulated its intention that in the modern National Health Service (NHS) a foundation for a changing health care system must be formulated in which the barriers between professions are removed. This allows collaboration with other agencies concerned with the health, social well being and economic development of the population to occur. As each profession strives to ensure that its practice is evidence-based, cost-effective and can be clearly shown to benefit the patients or clients it is important that professional boundaries are identified and clarified so that areas of overlap are redefined and restructured. In the multi-disciplinary, collaborative environment of the MSc. CPD (Health) the 'learning community' which is formed enables participants to explore their paradigms of practice as they share experiences and draw on communal knowledge. This was eloquently summarised by one student commenting on her impression of a computer conference, *"... discussion is available to the whole group - and we can build on each other's contributions in the conference area which provides opportunities for collaborative decision making through negotiation at all times."*

The multi-disciplinary approach enhances a deeper understanding of the theoretical and practical concepts in the context of the diverse social, economic and political health environments in which the participants work. From an educational perspective there is evidence that through collaboration significant and deep-level learning occurs. In the CMC environment discussion between peers, colleagues and experts is a major feature of the learning process. This discussion is archived and available for re-examination and reconsideration, and it is possible to see in the interactions how the participants are actively searching for the deeper meanings in the debates and arguments presented by their colleagues. Is this the beginning of virtual ethnography? Perhaps this is a question we will soon be able to set about answering.

Reflective Practice

Reflective practice, described by Thorpe (1993) as, *"...the key process in professional learning,"* is a fundamental concept within the programme. This is in line with current moves in all the health professions towards evidence-based health care that advocates reflection on practice to ensure that such practice does not become merely routine. That this is happening is borne out by a comment from one student, *"reflection in/on action since beginning the MSc. has influenced any tendency to be prescriptive..."* Reflective practice is a complex process of learning from experience and involves challenging the taken-for-granted assumptions, values and norms of practice. Participants work individually applying different models of reflection to their own practice and collaborate in the computer conferences to question the purposes of reflection and to examine the extent to which reflection can shape, improve or enhance professional practice. They achieve deeper understanding of whether or not reflection can lead to better practice and whether reflective practitioners are more effective in practice. Another student wrote, *"For me it was the collaborative/shared learning experiences which helped me to at least begin to unravel the reflective process at an academic level as distinct from what the majority of us would, I suspect, claim to have already been doing within our professional practice."*

Critical Thinking

The ability to think critically is fundamental to work at Masters level. Students need to be able to interpret and evaluate sources of information, not only text and research findings but also conversation, discussion and argument. Critical thinking is reasoning in which problems are formulated, assumptions are identified and challenged, alternatives are explored and facts and values that result in credible actions and beliefs are justified. In the computer conferences the students are encouraged to apply their critical reasoning skills with a positive and non-judgmental attitude. One student commented, *"... this critical thinking and analysing of findings is vital for healthcare professionals to enable us to stake out our own professional autonomy."*

Research

At the end of the Masters programme the students produce an individual piece of research relevant to their own practice. The evidence we are collecting suggests that their collaborative and reflective work in the conference areas enhances their acquisition of research skills and adds an extra dimension to their development as researchers. One student wrote, *"... I thought the bit on qualitative statistics and analysis was well-led and therefore it inspired more collaboration,"* which is not the usual sort of comment heard on a research methodology unit! This (lengthy) quote from another student encapsulates what we hope to achieve, *"... in the unusual nature of CMC classrooms, it is fascinating to watch the evolution of students' research ideas from first thoughts to the final version of the research project. It is unusual because, following a traditional degree pathway, students and tutors would not have intimate insight into the development of each of our research projects. In effect we are baring our souls for all to see and opening ourselves up to constructive criticism. The evolution and the shaping of our research ideas gives us, students and tutors, an extremely rich source of information: indeed this information is privileged, would students and tutors on other degree pathways have this opportunity to share such information? I doubt this very much."*

Conclusion

In this paper we have attempted to show how we have begun to harness some of the potential of communications technology to facilitate the continuing professional development of health professionals undertaking a Masters programme. We have demonstrated the use of relatively low-level technology and discussed the merits and advantages of this approach. We have not dwelt on the disadvantages. We are certainly not suggesting that there are no disadvantages, but our experience so far indicates that these are far outweighed by the advantages. We hope that we have been able to show the potential transferability of our chosen model to other professional groups and welcome the discussion this paper might initiate.

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Bringing Asynchronous Learning Networks into the Mainstream at NVCC

John Sener
Extended Learning Institute
Northern Virginia Community College, USA
jsener@nv.cc.va.us

Abstract: Northern Virginia Community College (NVCC)'s Extended Learning Institute (ELI) is currently bringing online learning 'into the mainstream' at NVCC through a large-scale deployment of Web-based courses in key disciplines. This diffusion strategy includes developing online Associate in Science (AAS) degrees in high demand (Information Systems Technology, Business Management) or of special interest (Public Management), and also on-campus courses with ALN components at all five NVCC campuses. The project addresses Northern Virginia's needs for access to "anywhere, anytime" educational opportunities, particularly for information technology and public sector workers. Incorporating asynchronous learning networks (ALNs) into courses enables utilization of rich content resources and levels of interaction among learning participants comparable to classroom-based courses. The project thus far has enabled significant opportunities for innovative and effective Web course design, including use of several Web-based development and delivery tools, use of publisher-created content resources, affordable Web-based transmission of mathematical expressions, and cross-course content linkage.

Project Background and Significance

ELI as a Distance Education Provider

Northern Virginia Community College (NVCC) is the 2nd largest multi-campus community college in the United States and the largest educational institution in Virginia. NVCC currently (Fall 1998 semester) enrolls over 37,000 students. As NVCC's distance learning administrative unit, ELI is one of the nation's oldest, largest, and most successful distance education programs. Since 1975, ELI has enrolled over 160,000 students in its courses; ELI currently offers over 140 courses and enrolls over 10,000 students annually. ELI offers entire distance education degree programs in General Studies and Business Administration and has also developed the first and only Associate in Science (AS) in Engineering degree program available in the United States through home study distance education.

Since it primarily serves students who cannot or prefer not to attend regular classes on campus, ELI has relied largely on asynchronous, or time-independent, forms of distance education delivery such as print materials, computer conferencing, voice mail, and pre-recorded telecourses or other video programs. ELI students highly value self-paced, independent study because of its flexibility and convenience. However, most of ELI's learners live within 20 miles of one of NVCC's five campuses and can handle occasional campus visits for exams, laboratory exercises, or other course-related activities. Most ELI courses also offer continuous enrollment, enabling students to register on any day of the year.

Consistent with the community college mission to provide maximum access for learners, ELI has generally relied on proven, reliable, inexpensive, and easy-to-use technologies which minimize access barriers (Sener 1997a). Accordingly, ELI's entry into development of Web-based courses has been relatively recent, coinciding with a sufficiently large market penetration of home computers and Internet access.

The project's major activities address the following needs: the need for accessible, anywhere, anytime learning, for information technology workers, and for expanded education opportunities related to public sector employment in Northern Virginia. Different strategies are being used to address each of these needs based on their particular characteristics.

Need for Accessible, Anywhere, Anytime Learning

This project addresses the problem of providing accessible educational opportunities to the growing "new majority" of potential students who seek to further their education and attain degrees but have significant obstacles preventing them from attending traditionally-structured on-campus classes. Community college programs in the U.S. are increasingly attractive to adults of all educational attainment levels who wish to enhance their prospects for promotion, find new jobs, or even change careers. Community college students also often have other demands on their time such as work and family responsibilities, making it more difficult for them to attain a degree by attending regularly scheduled classes on campus. These factors help explain the increasing popularity of asynchronous learning networks (ALNs) and other forms of accessible, anywhere, anytime learning delivery systems. ALNs provide access to remote learning resources at the learner's convenience, not dependent on synchronous, real-time communication. This includes 'people resources' who participate in the learning process (e.g., faculty, tutors, peers, guest experts) and the wide variety of possible content resources (e.g., lectures on demand, libraries, computer simulations, collaborative work products, et al.). Assuming that learning follows from supporting access and interaction, ALNs increase opportunities for interaction and collaboration among learning participants (Mayadas 1994).

This project will result in the development of at least 40 courses which utilize ALN in a variety of formats, including entirely online, Web-based ALN courses, largely online courses with one or several face-to-face meetings, and on-campus courses with Web-based ALN components. Half of these courses will enable online offering of AAS degrees in Information Systems Technology (IST), Business Management, and Public Management; the remainder of the courses are being selected for development in a wide variety of disciplines within all major divisions at each of NVCC's five campuses, assuring a widespread diffusion of 'model' Web-based courses throughout the College. As the largest and most far-reaching such initiative at NVCC, this project is creating a critical mass of distance education and on-campus offerings which will establish Web-based ALN courses as a self-perpetuating norm at the College.

Need for Information Technology Workers

The AAS IST degree program is designed to address the critical shortage of information technology (IT) workers in Northern Virginia and the resulting high demand for IST courses at the College. The demand for workers in IT-related fields in the U.S. has grown at an unprecedented rate during the past decade, with recent estimates ranging as high as 346,000 unfilled IT jobs in the U.S. in 1998 (Information Technology Association of America 1999). High technology firms are a major component of the economy of the Northern Virginia region which comprises NVCC's service area. Northern Virginia now has the 2nd highest concentration of high technology industries in the U.S., ranking only behind Silicon Valley in California. Not surprisingly, the nationwide shortage of IT workers is particularly acute in Northern Virginia. According to recent estimates, almost 23,000 high tech jobs in the region are unfilled (Stough and Trice 1999) and 112,000 additional jobs will be available over the next five years (Ryan McGinn Samples Research, Inc. 1997).

The great demand in Northern Virginia for IT-related education and training opportunities is reflected in the demand for NVCC's IST courses. The IST program is designed for persons who need knowledge and skills in business computer information systems to enter or advance in the field, or for persons who wish to apply IST to their current fields. IST is one of the largest programs at the College with over 2,200 program-placed students. Accordingly, the IST and related courses are being designed to accommodate moderate to high enrollments, as this program is expected to produce at least 1000 course enrollments per semester when development is completed in Spring 2000.

Need for Education Opportunities Related to Public Sector Employment

The AAS degree program in Business Management, including the Public Management specialization, addresses the need for education and training opportunities relevant to public sector employment in Northern Virginia, with its high concentration of federal, county, and state government employees. Although federal government employment in the region has not grown in recent years, employment at the county and state levels has grown. There is a particular need for education and training for historically underserved populations such as public safety and support employees. These populations have been overlooked since most public administration programs of study in the U.S. focus on producing Bachelor's and Master's level graduates. However, community colleges are highly suitable institutions to provide opportunities for these populations to obtain a successful and rewarding education experience in the field of public administration (Banas and Emory 1998).

Although the Business Management degree program is well established, the Public Administration specialization is a new one with relatively low enrollments thus far. Accordingly, several strategies are being employed to increase program enrollments. These include designing all of the related program courses for nationwide availability; making versions of the courses available in a variety of formats, including online, compressed video, classroom, and on-site delivery; and developing customized certificate programs on demand for employers and other clients with a sufficient cadre of employees with specialized needs. When completed, the Public Administration specialization will be one of only two such Associate degree programs available in the U.S. through distance education.

Program Implementation Issues

Any large-scale program implementation is accompanied by a number of related issues. Some of the key program implementation issues in this project include ensuring accessibility and affordability, selecting software and technology, promoting learner interactivity, providing adequate support services, and ensuring effective program evaluation. Of particular interest here are those issues related to software and technology implementation.

Software and Technology Implementation

One important set of decisions which must be made in any large-scale implementation of Web-delivered courses is what software and technology to use. Such decisions include the following:

Off-the-shelf tools or make your own? This was an easy decision to make for this project: NVCC/ELI does not have the resources to make its own Web-based instructional development or delivery products, so commercial software products are being used.

Standardize on one product set or allow many? Although there are many advantages to requiring faculty to use one set of Web-based development and delivery products, ELI decided to support many such products for several reasons:

- In our opinion, none of the currently available commercial products are so superior to the others that they merited exclusive selection.
- Because of ELI's "faculty-centered" course development model which gives faculty primary responsibility for and 'psychological ownership' of course development and delivery, it makes more sense to give faculty more freedom to select the tools they will use. Given the current state of

evolution of Web-based products, any selected product set is likely to dissatisfy many faculty who do not like that particular set of features.

- Much faculty course development is "textbook-driven," i.e., faculty instructional design decisions determine which textbook is selected for the course, which in turn drives software and technology selection. This is because more and more textbook publishers are supplying Web-based software and content as an enhancement to their textbooks. Some publishers are creating their own Web content and/or integrating external Web sites into their textbook content available in CD-ROM format. Many other publishers are also bundling Web development and delivery tools with their textbooks, with or without accompanying content. For example, McGraw-Hill Learning Architecture uses TopClass™ (McGraw-Hill 1999), Course Technology uses CyberClass™ (Course Technology 1999), etc.

Consequently, ELI is currently using a variety Web-based development, delivery, and management software tools, including Web Course in a Box™, CyberClass, and Serf™. Other faculty are choosing to build their own Web pages using many of the currently available tools such as Netscape Composer™, Microsoft Front Page™, AOL Press℠, et al. ELI also uses Allaire Forums™ as a Web-based conferencing software tool for faculty who wish to integrate discussion forums into their courses.

Strategies for Innovative Web Course Design

A common criticism of many Web-based courses is that they are little more than "page-flipping" courses containing computer-based information with little use of the Web's special capabilities for enhancing instruction. This project is providing the opportunity to apply several effective strategies for innovative Web course design.

Rich Content

Incorporating ALNs into course design provides an effective framework for developing effective learning environments because it requires integration of substantial content resources as well as activities which promote interactivity among learning participants (Sener 1997b). The quantity of Web-based content of instructional value has rapidly increased, as have ways to organize and use this content effectively. For instance, the textbook to be used in ELI's Introduction to Speech Communication course includes hundreds of content-related Web sites which is directly referenced to textbook content by page number; the publisher's web site even uses software which "regenerates" dead Web links by automatically identifying a suitable alternate link when a referenced Web link becomes inactive (Allyn & Bacon 1999). Similarly, there are numerous non-commercial sites such as The Electronic Hallway (University of Washington 1999), which has a repository of case studies suitable for use in course assignments, as is done in ELI's public administration courses.

Promoting Interactivity among Learning Participants

In designing ELI's Web-based courses, the standard of desired level and quality of interactivity among learning participants is that the opportunities for interaction are equal to or greater than those available in the comparable classroom course. In some cases, this is a relatively modest standard to meet, as many classroom courses do not necessarily generate much interaction among learners or between learners and other learning participants (instructor, tutor, etc.). Consequently, some courses rely more on optional interactivity, i.e., available upon demand, while other courses integrate mandatory interactivity into their assignments (e.g., collaborative projects, homework assignment review, etc).

Mathematics on the Web

Enabling two-way electronic transmission of graphics, equations, and formulas has always been a particularly vexing problem. ELI previously developed a serviceable means of accomplishing this by using Expressionist and FirstClass™ (Sener 1997a), enabling electronic transmission of mathematical expressions using a remote server accessible via local telephone service. However, this solution was not technologically feasible for Web-based courses, so a new solution had to be found.

The current Mathematics for the Liberal Arts I course uses Scientific Notebook™ (SN) as the means of mathematical communication with students. The instructor and students use the software to transmit quizzes, homework problems, and general questions and answers to each other. The software is priced very affordably (currently <$30US/copy) as it is bundled with the course textbook. SN can be used as an equation editor; it also has a lot of computational power as is it incorporates the symbolic engine from Maple™, and it has one of the easiest user interfaces of the available math software packages. Since it is not currently possible to post SN files directly on the web, the instructor uses MSWord™ with MathType™, the full version of the Equation Editor that comes with Word to post Web pages with mathematical content (Goral 1999). This procedure is much easier and quicker to download than the previous common practice of embedding mathematical expressions within graphics on Web pages.

Cross-Course Content Linkage

One particularly exciting set of possibilities enabled by a large array of Web-based courses is linkage of content across courses. The instructional possibilities of cross-course content linkage are just beginning to be explored; one strategy which ELI is using is to link "helper" courses to other academic courses. One of ELI's new courses, Library Skills for Research (LBR 105) is a one-credit course designed to teach students basic library research skills, including online research (Egan, Delmore, and Wharff 1999). The course includes mandatory participation in discussion forums which are monitored by librarians at each of NVCC's five campuses. Other Web-based courses with a research component are starting to use the library research skills course as a resource by including a link in their Web pages to the LBR 105 course for students who need additional assistance in completing their research assignments. Students can use the linked LBR 105 content as a refresher or reference resource, while students who need more extensive assistance can sign up for the course and receive online assistance from the librarians.

Project Status

Currently (Spring 1999 semester), seven courses are being offered with over 280 enrollments; an additional ten courses will be available in the Summer 1999 semester. When the project is completed in the Spring 2000 semester, the complete AAS degree programs in IST, Business Management, and Public Management will be available. A complete Associate in Arts degree in Liberal Arts will also be available starting in the Fall 1999 semester.

For more current information on this project, visit the "Bringing ALN into the Mainstream at NVCC' project website link at http://elisp.nv.cc.va.us/.

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New Tools for Synchronous and Asynchronous Teaching and Learning in the Internet

Volker Hilt
Christoph Kuhmünch
Lehrstuhl für Praktische Informatik IV
University of Mannheim
Germany
{hilt,cjk} @pi4.informatik.uni-mannheim.de

Abstract: In this paper we describe the new tools for synchronous and asynchronous learning developed within the context of the TeleTeaching Projects at the University of Mannheim. With our tools, students are enabled to follow lectures not only in the lecture halls of the connected universities but also at home. The innovative processing of course material allows the production of educational documents that consider the requirements of synchronous and asynchronous learning modes out of a single primary document. Course material is provided within a Web-based training unit designed specifically to support asynchronous student learning.

1. Introduction

In the Fall of 1995 the University of Mannheim initialized a joint Teleteaching project with several partner universities (Eckert et al. 97) in Germany. Three different synchronous Teleteaching scenarios were implemented and evaluated. In these synchronous learning scenarios, production and consumption of the educational material takes place at the same time. The first scenario is called the ``*Remote Lecture Room Scenario*'' (RLR). Lectures are transmitted live via the Internet to lecture rooms at the partner universities. Transmission is entirely based on the Internet protocols so that students from anywhere can participate easily. The second scenario we explored is called the ``*Remote Interactive Seminar*'' (RIS). In contrast to the RLR scenario, a seminar is much more interactive since a discussion between the three sides usually takes place after each talk. The third scenario is called ``*Interactive Home-Learning*'' (IHL). Its target users are students running Linux or Windows 95/98 on their PC at home having an Internet connection via ISDN. This scenario is the most widely distributed among its members. The Goal of the IHL project is the provision and interactive usage of multimedia teachware within the bounds of academic education over digital networks in order to gain experience. From a pedagogical point of view information about the acceptance and learning success of such a scenario should be retrieved.

In addition to the synchronous scenarios, *asynchronous* learning is supported. In the asynchronous scenario, the student is provided with course material for the lectures and seminars. This material can be reviewed at any time and at the speed the student desires. Especially in the preparation for an exam, access to course material is viable for the students. Besides the material used in the lecture (slides etc.) additional documents are handed to the students in the asynchronous scenario. E.g. the video and audio recordings of the lectures provide access to the explanations by the professor of a specific topic. Further educational material (texts, animations etc.) may provide background information on selected topics of the lecture.

Many other related projects in the area of distance education exist (Bacher et al. 97) (Baehring et al. 98) (Schill et al. 98) (Parnes 97) (Maly et al. 97). Howerver in contrast to the other projects, our approach integrates synchronous and asynchronous forms of learning. The main features are the automatic production of educational material for both forms of learning from a single primary document. Furthermore we provide students access to the synchrounous and asynchronous learning scenarios from their home.

2. Synchronous Scenario

Our main goal in the synchronous scenario was to gain experience in the transmission of lectures to student households via ISDN. Thus an infrastructure had to be established and software components designed and implemented. From an pedagogical point of view information about the acceptance and the learning success of the scenario had to be obtained. (Fig. 1) depicts the synchronous IHL scenario. Lectures were transmitted via high-bandwidth ATM connections to the remote lecture rooms and simultaneously to the student PC at home via a low-bandwidth ISDN connection.

2.1. Implementation

During the summer semester 1998 we evaluated the scenario. Four groups of participants were selected and equipped in order to attend to our teleteaching lectures. The first group of participants attended the lectures directly in the classroom where the lecture took place. The second group of participants was located at a partner university, connected via ATM links with a reserved bandwidth. The reserved link allowed the transmission of high-quality video of the lecturer. The third group consisted of participants who attended the lectures individually at various universities in Germany, connected via the public MBone, i.e. they depended on the best effort IP protocol for packet delivery without bandwidth reservation. The fourth group consisted of students who attended the lectures individually at home. These participants were connected via ISDN and used multimedia PCs running Linux or Windows 95/98 or NT. Since ISDN provides a reserved bandwidth of 64 kbit/s or 128kbit/s (if two channels are combined) the students could depend on a relatively reliable connection, although the bandwidth available is relatively low.

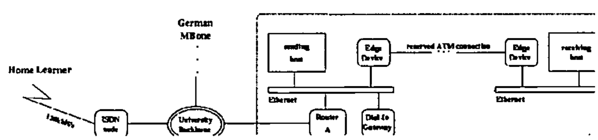

Figure : The Integrated Home Learning - Teleteaching Scenario

It proved to be a complex task to set up a multicast connection among these different groups of participants. (Fig. 1) depicts our solution: The reserved ATM connection to the participants of the second group was provided as a Permanent Virtual Circuit with a peak bitrate of 3 MBit/s. Upon this PVC a LAN emulation was set up: At both sites Edge Devices were installed which acted similar to remote repeaters. Ethernet frames were transmitted over ATM connections. Since participating hosts could be connected through conventional ethernet this solution allowed a flexible integration of new hosts into the virtual LAN. A dedicated router equipped with two Ethernet interfaces acted as multicast gateway to the MBone (router A in (Fig. 1)).

The simultaneous transmission of multicast streams through high-bandwidth ATM connections and low-bandwidth ISDN connections creates two technical problems: At first, the transmission of high-quality video requires a high bandwidth of at least 600kbit/s but ISDN provides only 128kbit/s. . Second, broadcasting networks like Ethernet inherently allow multicasting. Since ISDN is not a broadcasting channel, a tunnel must be set up dynamically in order to transmit multicast data.

The *Dial-In Multicast Gateway* allows the transmission of selected teleteaching lectures sent via IP multicast, over dial-in connections such as ISDN. It sets up tunnels dynamically; thus selected multicast sessions can be transmitted through channels without multicast capabilities. Furthermore it includes a simple filtering mechanism that scales the bandwidth needs of transmitted streams according to given priorities. For each selected media stream of the lecture the desired quality of service parameters can be set interactively, e.g. a certain share of the available bandwidth can be reserved. In order to allow a graceful scaling of video we integrated a simple scaling mechanism for H.261 video streams that controls the temporal resolution of the video.

In principle the gateway works in the following manner: Users connect to the server through the client application. Once a user has logged in the client will receive a list of lectures available for transmission. The user will then choose which lecture to join. A request for each selected media streams of this lecture will be sent to the server, which then will transmit and rescale the media stream according to the bandwidth available. A more extensive description of the Dial-In Gateway can be found in (Kuhmünch 98).

2.2. Evaluation results

During the summer semester 1998 a lecture on Multimedia Technology by Professor Effelsberg was implemented with the technology described above. The remote classroom was located at the University of Freiburg. A Web-based questionnaire was used for the evaluation of the synchronous scenario. Besides sozio-demographic information it assessed aspects of motivation, the technical, organizational and didactical quality of the scenario and several aspects of the subjective bearing and perception during the teleteaching lessons. The questionnaire was similar to the standardized questionnaire HILVE (Rindermann et al. 94). Also assessed was information on the software tools for the ISDN users.

A total number of 65 students attended the lectures. 43 students participated directly in the classroom, 12 students studied at home and 10 students in the remote classroom, connected through the virtual LAN. Since the number of participants in each group is small and differs widely we had to dispense with inference-statistical evaluations. The following evaluations therefore are purely descriptive but we refer to related evaluations of other projects where possible in order to buttress our interpretation of the evaluation data.

Comparisons between the ``remote situation" and the ``local situation" showed that the students always gave a higher rating to the ``local situation". The Home Learning students as well as those in the remote classroom rated perception in a ``normal" face-to-face lecture higher. The reasons mentioned were the unfamiliarity of the video on the screen or the video beamer and the poor audio quality combined with the merely sufficient visual quality of the slides in the whiteboard. Additionally students in remote situations do not feel themselves to be perceived by the lecturer as well as they would have been in the local situation. They also reported difficulties concentrating for a full, uninterrupted 90-minute lecture. In order to overcome this problem, we introduced a 5-minute break after the first 45 minutes. These evaluation results coincide with those in (Eckert et al. 97).

We evaluated how the students assessed the quality of the three media types audio, video and whiteboard with respect to their importance in the learning process. Since Home Learning students and those in the remote classroom received the lecture in differing qualities the interpretation of their results are discussed separately. (1.) Home Learning students: The evaluation data gives reason to the hypothesis that video is only of minor importance in computer science lectures, although the received quality was rated as merely sufficient. In contrast the importance of audio and whiteboard was rated high. While the whiteboard quality received good ratings the audio again was perceived as merely sufficient. (2.) Students in the remote classroom: Obviously the students in the remote classroom demanded higher quality of the video. They rated to the importance of video average and the importance of whiteboard and audio as high. While the video and whiteboard quality fulfilled the student demand the audio quality was rated as needing improvement.

Specific questions designed for the evaluation of the Home Learning scenario indicated that the participants were partly motivated by technical interest in ISDN and partly by personal contact to the department. Additionally some students found it advantageous that they did not have to commute to the university. Frequent problems with the gateway router (router A in (Fig. 1)) caused the reliability of the connection to receive only an average ranking. Nevertheless all students would participate in the experiment again, especially if higher bandwidth (provided for example over ADSL) were available.

An important finding is that the Home Learning scenario is generally accepted by students although higher bandwidth is obviously necessary. Nevertheless students in the remote classroom as well as the home learning students reported a less personal atmosphere. This result coincides with other evaluations (Eckert et al. 97).

3. Asynchronous Scenario

3.1. Objectives

One of the main goals of the asynchronous scenario is to provide the student with educational material that can be visited selectively depending on one's personal learning process. The material usually accompanies a lecture that is held in the synchronous scenario. In contrast to the synchronous scenario, where content is *pushed* towards students, the asynchronous scenario enables a student to selectively *pull* the desired material. Due to this fundamental conceptual difference, the range and the amount of material presented in the asynchronous scenario may be much greater than in the synchronous scenario. Additional material may also be used to explore certain topics of the lecture in more depth or to address different needs of learners by providing compact explanations for fast learners and full texts for slower ones. Since students interact directly with the material, highly interactive material like animations and simulations can be handed to them.

3.2. Preparation of Course Material

The lecture material of the course on Multimedia Technology given in the summer semester of 1998 was presented not only during the synchronous lectures but was also provided for asynchronous learning. Since the demand of lecture material in both scenarios differ, a novel authoring process was developed that allows efficient production of material for both. We also set up a system which allows the material to be captured that was created during the synchronous lecture.

3.2.1 Authored Material

For the material authored by hand (e.g. the slides of a lecture) we found it to be a great advantage to leave the choice of the authoring tool to the lecturer. This enabled the lecturer to efficiently create the course material because no time was needed to learn the operation of a new tool. The lecturer may also reuse any material he has created previously with his favorite authoring tool. This will tremendously reduce the amount of time required to prepare a lecture, especially if material from previous semesters is used. The documents produced with the chosen authoring tool are in a tool-specific document format (e.g. Microsoft Word format) which is usually not appropriate for the presentation of the material. We call this document format a *primary format.*

As mentioned above, the lecture material in the synchronous scenario is presented using the MBone whiteboard wb (Jacobson 92) which is able to process documents in postscript format. Within the asynchronous scenario, the course material is provided on the teachware Web server. Since both scenarios must be considered during the authoring process, a conversion from the primary format to multiple *presentation formats* is required. This conversion process should be executable with minimal user interaction. In particular, it should not be necessary to edit the conversion results, because these changes would be lost if the conversion process is repeated.

The authoring process we have implemented allows to produce the presentation formats postscript, PDF and HTML out of a single primary format document. The authoring process is subdivided into three steps. In the first step, the document is edited using the desired authoring tool (in our case, Microsoft Word). In the second step, the document is converted to the presentation format. In contrast to postscript and PDF, the conversion to HTML proved to be very difficult. Our experiments with HTML export filters showed that the resulting HTML documents often could not be post-processed any further. Very good results were achieved by exporting a document to the RTF format and converting the RTF document to HTML. This process is suitable for all authoring tools that are able to export RTF documents and therefore does not restrict the flexibility in the choice of the authoring tool.

In the third step of the authoring process, the HTML document resulting from step two is post-processed for its actual presentation. Using a Perl script, the WBT described in Section 3.3 is automatically generated. To accomplish this task, the script reads a configuration file in which the linking structure of the WBT is specified and inserts appropriate links into the HTML documents. The configuration file can be edited by the author to specify further material that should be integrated into the WBT.

3.2.2 Captured Material

Course material can be gathered during the live lecture by recording the audio and video data. In our case, we recorded audio and video using the MBone VCR recorder (Holfelder 97).

Besides audio and video, an important source of material are the slides that are presented by the lecturer using the wb. In contrast to the audio and video data, wb data cannot be recorded with a state-of-the-art recorders like the

MBone VCR. But even if the data of the wb could not be recorded directly in the past semester, it proved to be a good source of information for assigning parts of the recorded audio and video to the corresponding slides of the lecture. The recording of a lecture comprises the full 90 minutes. In order to determine the parts which belong to a single slide, the recording must be indexed. This indexing is done automatically during the recording of the lecture by our tool *listenwb*. This tool examines the data stream produced by the wb. It records the time at which a slide is changed in the wb. This point in time is converted to a timestamp relative to the start-time of the video and audio recording by subtracting an offset. At the end of a recording, an index is created by listenwb which contains the timestamps of page changes relative to the beginning of the video and audio recording. This index is the foundation of the configuration file used by the perl script in the generation of the WBT.

3.3. Web-Based Training (WBT) Unit

The complete course material of the 1998 Multimedia Technology course was combined into a WBT (Effelsberg 98). This WBT integrates all the material (hand-authored and captured) and provides access through the common user interface of a Web browser (Fig. 3).

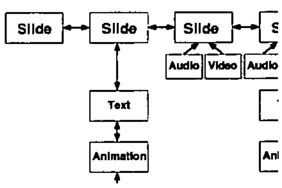

Figure 2: Instructional design of the WBT

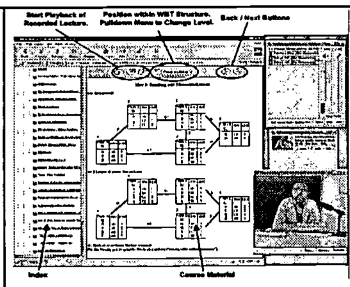

Figure 3: Screenshot of the WBT

3.3.1 Applying an Instructional Design

A very important aspect of a WBT is the appropriate structuring of the material it contains. For this reason, the instructional design of the WBT (Fig. 2) was developed in cooperation with a research group at the Department of Psychology at the University of Heidelberg under the direction of Professor Reimann. The foundation of the WBT consists of the slides of the lecture. These slides are linked in the order in which they were presented during the lecture. Each slide contains a forward and a backward button in the *navigation bar* on top of the screen (Fig. 3). This allows a student to successively walk through the complete course. Additionally, a self-expanding index enables a student to access material on a specific topic. Each slide contains a link to the corresponding part of the video and audio recording of the lecture. Some of the slides contain links to additional material. This additional material is structured in multiple layers where each layer contains different material (full text, animations and exercises) on the same topic as the slide. Thus, a student may descend through different layers until the topic has been completely understood. Afterwards, the student ascends to the upmost level and continues with the next slide. Currently we have integrated Java animations and exercises into the WBT; the integration of full text will follow

4. Conclusions

In this paper we summarized our synchronous and asynchronous teaching and learning scenarios. We described details of the technical implementation and presented initial evaluation results which prove that teleteaching in its synchronous mode is generally accepted by the students although they expect high technical and organizational quality. For the asynchronous scenario, we presented an innovative course material processing scheme that enables the production of educational documents considering the requirements of different learning modes out of a single primary document.

Future work aims to add interactive media such as VRML or Java animations and simulations as new educational paradigms to our asynchronous and synchronous teleteaching scenarios. This comprises the development of a general framework for the transmission and recording of interactive media (Mauve et al. 98).

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Project Clio: Tools for tracking student use of course webs

Raphen Becker, Kevin McLaughlin, and Samuel A. Rebelsky
Department of Mathematics and Computer Science
Grinnell College
Grinnell, Iowa 50112
{beckerr,mclaughl,rebelsky}@cs.grin.edu

Abstract: In this paper, we present *Project Clio*, a Web logging system that permits instructors, instructional designers, Web designers, and course web architects to better garner information that helps them understand how students use course webs, and therefore how to improve course webs. In particular, the system allows one to determine the path(s) individual users follow through a site, the time they spend on each page, and their simultaneous use of multiple pages. While there are now a number of systems for logging Web use, ours is able to provide more targeted and more individualized information than typical systems.

1. Introduction

Students at most universities now have access to the World-Wide Web, putting the Web in a position to be the common medium of hypermedia for class materials. Hypermedia has many advantages over a paper-based presentation of information. Of primary importance are that hypermedia (1) permits the easy integration of media other than text and (2) supports a structure quite different from the linear presentation of textbooks. Links allow students to access related material easily, from various nodes in the course web.

At the same time, this new technology requires analysis of its use and usefulness. Instructors need to know how students actually use Web materials so that they can better learn how the Web and their course webs affect students' understanding of information and their performance in class. Such analysis requires careful and regular gathering of information on how individual students use course webs.

The Web was not originally designed to provide a great deal of specific information on how readers use individual sites and pages. The log files generated by most Web servers, such as the NCSA HTTPd (NCSA 1997) are inadequate for careful analyses. In particular, log files list only pages accessed, the time the page was accessed, and the machine that issued the request, but not the individual that accessed the pages, the previous and next pages on that individual's exploration of the Web, or the amount of time the person spent on the page. Successful acquisition of more detailed data requires working around this original design decision. Recently, new technologies such as cookies, Java, and Javascript have extended the opportunities not just for hypertext on the web, but also for tracking and analyzing use of the Web. Using these technologies it is now possible to track students more closely as they move within and beyond the course web. In particular, we can log the path of each particular student and record the time each student spends on each page.

2. Improving Understanding of Site Usage

Why analyze course webs? The primary goal of course web analysis is to help teachers, site designers, and instructional designers as they evaluate the use and usefulness of course webs. By "evaluate use", we mean an analysis of what pages students use, how long they use them, how they get to them, how they leave them, and what other pages they use in conjunction with those pages. By "evaluate usefulness", we mean a consideration of the effects of pages and use patterns on learning, based not just on the preliminary analysis, but also with additional information such as records of student performance or targeted interviews, as in (Jones et al. 1996).

There are many potential benefits from more thorough analysis of course web usage. These include a better understanding of student learning patterns, justification for the time and effort spent developing a site; and support for improving the site. While such benefits can also be gained in careful study of commercial sites, the focus of our tool is on understanding student patterns.

Information presented with hypermedia does not need to appear in linear format as in a lecture or in a text book. This change can have a dramatic effect on how well students learn and retain course material. An analysis system can allow instructors, instructional designers, and course web architects to correlate viewing information on the Web with related test questions (Trochim 1996), student interviews (Jones et al. 1996), or student perceptions of their own web use (Rebelsky 1998).

With more detailed usage logs, one can also ask questions like

- What are the more popular parts of the course web, and are those parts used more for their links (short time on page) or content (long time on page)?
- How do readers reach particular pages? Can they quickly reach the pages they want?
- How do better and worse students use the web? Can all students benefit from the strategies of the best students?
- Which pages do students seem to leave active, perhaps as a reference in a background window, while visiting other pages? Are there ways to improve the use of reference pages in such situations?

To permit these sorts of analyses, a logging system must identify students, keep track of the paths they take through the course web, and identify the amount of time they spend on individual pages. This means the system needs to log when a reader loads a web page, how they found the page, how long the page is open, and which link (if any) is followed next. Because the web permits readers to open multiple "windows" on the same site, we also need to be able to determine when they have several pages open concurrently.

3. Architecture

Project Clio is based on a number of interconnected systems, each of which provides a different role in tracking or helping analyze student use.

- An *identification system* (described in section 3.1) identifies individual users and provides this information to the other parts of the system.
- A *page transducer* acts as an intermediary, fetching requested pages and extending them so that (1) they can be tracked with the tracking system, (2) links from the page use the transducer for subsequent requests, and (3) additional activities can be performed during the fetch.
- A *tracking system* (described in section 3.2) records simple events which are then used to develop usage information. This system includes:
  - an *event logger* which logs individual events to a file for later analysis;
  - a *request analyzer* (server side) which garners information from the initial page request; and
  - a *page observer* (client side) which garners information from the client, such as whether the student is still on the page.
- A *synthesis system* which translates the "raw events" (such as "the user has loaded page *X* ... the user is still on page *X* ... the user has left page *X*") to a more usable form (such as "the user was on page *X* for five minutes").
- An *analysis system* which permits interactive analysis of the translated usage information and supports questions like those given above.

In this paper, we focus on how the system tracks users with an identification system and a tracking system.

3.1. The identification system

The identification system is loosely modeled after the Unix model of users and groups. Each user entry contains a single line in a file that contains all of the information for a user. Each entry contains the *account* name of the user, an encrypted *password*, the *groups* that the user belongs to, the *real name* the real name of the user (or anonymous, for users who do not wish their name to be known), and an *email* address for contacting the user.

We use a group model so that different types of tracking are possible. For example, one might want to compare different classes using the same web site or only log members of a particular group. The group model is also appropriate for related uses of the system, such as an annotation system which takes advantage of this system (Luebke and Mason 1998) (Luebke, Mason, Rebelsky 1998).

When users first access pages that are logged, they are prompted by a form that asks for account and password. Once the user has logged in, a session and session identification number are created for that user. As the user continues throughout the logged pages the session identification number is carried with them via query strings and cookies. Once the user exits the logged pages or leaves the browser the session number is expired and they must login again if they choose to return to logged pages. In this way, only registered users of the system may view the logged pages. This can easily be circumvented by allowing a guest account. In the future it should also be possible to restrict certain pages for certain groups or to restrict logging to certain Internet domains (so that, for example, internal users might be logged but external users would not be).

The identification system is not only essential in providing access control to pages. It is also essential in keeping track of users as they move around the logged pages with the tracking system. With the identification system, each time a user enters a page, both the user name and session number can be immediately identified. These pieces of data are used in constructing the log files for each user.

3.2. The tracking system

The tracking/logging system is used to record events for each user as they move around the logged webpages. To improve the accuracy of the tracking, *tracking events* are gathered in a variety of ways. The tracking system includes a server, a Java applet, Javascript scripts, and several CGI scripts written in Perl. These various components report events to the server for each session. Selected events are describe in Table 1.

Event #	Sent by	Event type	Data sent
00	observer: applet	left page	page left
01	request analyzer	loaded page	page loaded; previous page
02	request analyzer	from page	last page
03	observer: Javascript	Javascript enabled	current page
04	observer: applet	Java enabled	current page
05	observer: applet	stay on page	current page

Table 1: Events recorded by the tracking system.

As the user browses through the logged pages these events are generated and sent to a *log server* which writes them to a log file. Because it is traditionally difficult to determine when someone leaves a page (e.g., if the user switches to a page on another server, the current server gets no notice), the *stay on page* event helps us determine the amount of time on the page. One might also or instead record the time when the user leaves the page (Davis and Jain 1998).

Since we rely on Java and Javascript, problems may occur when the user disables them in the browser. This is the reason we record events 3 and 4. In the synthesis system, these events are looked for. If they are not found we know that Java or Javascript was not functioning properly and that we must use a different (and less accurate) mechanism for evaluating some aspects of traversal. Thus, analysis component accounts for this and tries to determine some synthesized events based on a wide variety of other events.

4. Anonymous Browsing

The question of anonymity with regard to the World-Wide Web is a common question. Is it acceptable for sites to track users paths through the web? We considered this issue in great detail while designing the logging system. For example, would students be less likely to use web pages if they knew their use was being logged, or would they "simulate browsing" to make it appear that they were using the system more than they were? In addition, what should be done about non-student readers of the course web? In some cases, such readers should be discouraged from using the web, but in many cases, use by non-students is certainly acceptable. How can one make it appropriately accessible to such users without hindering their own attempts to benefit from the materials.

It is clear that careful studies and interviews need to be done to determine all of the potential effects. As a temporary stopgap, we decided to provide two mechanisms that help alleviate some of these concerns. One is a permissions system incorporated in the identification system that allows the instructor to specify which domains require accounts, which domains do not require accounts, and which domains should be denied access. A second mechanism was to permit the instructor to specify that *anonymous* accounts are acceptable. Let us consider some details of anonymous accounts.

There are a number of options for anonymous browsing: one might use a single "anonymous" account, one might use multiple anonymous accounts (one for each user), or one might allow users to turn off logging. In the case of a single account, the administrator might distribute the password to all users with privileges to browse the logged pages. This method, however, has a distinct disadvantage. One purpose of the logging system is to determine paths for each student across sessions and not just in a single session. With a group guest account it is unknown what student is reading the web at a particular time. In addition, some students might use the guest account some of the time and their own account at other times, leading to unreliable data collection. Turning off logging is similarly unacceptable.

A better system for allowing anonymous browsing is to create accounts for all desired users and let the account names, real names, and email addresses be blank or pseudonyms. Such accounts may be distributed anonymously (e.g., with slips of paper in a hat). In this manner we can create distinct paths for each particular pseudonym and thus, each user. Regular analysis can be performed without any loss of accuracy. This is the preferred way to handle anonymous logging.

For many purposes, such as marketing and other corporate uses, the name of the user is the desired information. For our logging system, however, it is frequently not the name, but the the path taken by any particular user. Hence the actual name of the user is only useful for record keeping and is not needed to actually perform many analyses. Names are useful only when usage and success in learning are correlated in one of many possible analyses.

5. Related Work

There are a wide variety of systems for Web analysis. For example, the Internet Product Watch listed 116 "Analysis products" on March 25, 1999 (Internet Product Watch 1999). Of these, perhaps half are intended to gather and report site usage in some form or another. Many provide a wide range of reports. For example, Accrue Insight (Accrue Software, Inc. 1998) provides approximately fifty different types of reports. Is another reporting system needed?

Because many existing systems are targeted toward commercial webs, the answer is *yes, course webs require different systems*. One reason is simple: most instructors (and even institutions) cannot afford the commercial products, which are priced toward industry and not towards academia.

More importantly, existing products tend to focus on group data, rather than on individuals. For example, consider the eight "visitor" reports provided by Accrue Insight (Accrue Software, Inc. 1998): total visits, total visitors, new visitors, registered visitors, unregistered visitors, visitor types, visitor types, and average pages per visit. None of these reports give details about individual visitors; rather, they are mass statistics of number of "things" per "time unit". Similarly, consider the sixteen reports generated by FlashStats (Maximized Software, Inc. 1999): summary, top URLs requested, top referrers to your site, search phrases, most common browsers, bad URLs, bad referrers, user domain analysis, types of domains, daily totals, hits per day of week, and hits per hour. Again, these are primarily counts that reflect compound rather than individualized data. (FlashStats is limited to the information in standard log files; Accrue Insight uses a number of other technologies, including cookies, to gather additional data. Neither provides information on single users.)

By providing information on *paths* (including entry to web and exit from web), we are able to provide course web architects with the smaller-scale and more individualized information that they need. In fact, while some commercial software can track paths, that paths are used only as a means of collecting more general data, such as the first and last pages readers visit at the site (Page 1997).

There are also client-side technologies that can more closely observe users interactions with their browsers. We have chosen not to explore such technologies because (1) they require more effort on the part of the student; (2) they typically assume a one user/computer model that is not applicable in the academic setting; and (3) they are more difficult to implement and maintain in the typically heterogeneous academic environment. By relying on server-side tracking along with lightweight client technologies (e.g., Java), we are able to support a variety of browsers and computer platforms.

6. Future Work

We have developed working identification and tracking systems that have been been used for simple experiments during Summer 1998 and Fall 1998. Development of a sophisticated analysis tool for using the logs and a more robust tracking system is underway. When completed the tracking and analysis tools will provide the means to track users and answer questions about student usage, such as "How often and how much do students use particular pages?" and "How do students typically reach the most useful pages?". With the answers to these questions one can design more usable and more useful course webs.

One issue that is of particular concern for tracking paths through WWW sites is that a student may have multiple windows open on the same site at the same time. This is in stark contrast to the "one view" hypertexts that are typically analyzed, such as in (Jones et al. 1996). We plan to consider a number of possible static and dynamic mechanisms for visualizing the multiple *simultaneous* paths students take through course webs.

The identification and tracking systems are also being used to support additional facilities for course webs. The identification system has been used to support a group annotation system (Luebke and Mason 1998) (Luebke, Mason, and Rebelsky 1999) and will be used to support a system for building *trails* from both local and non-local pages. The tracking system may also be used to support a form of adaptive hypermedia in which pages can be modified based on prior use.

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Basic Support for Educational Study and Research - (BASES)

Prof. Dr. Peter Baumgartner
University of Innsbruck
Institute for Organisation and Learning (IOL)
Department of Business Education and Evaluation Research
Universitaetsstrasse 15
A-6020 Innsbruck, Austria
peter.baumgartner@uibk.ac.at

Dipl. Phys. Dirk Richter
Marienstr. 17
D- 37073 Göttingen, Germany
richter@judgy.de

Abstract: Research in the information society is undergoing radical change. The new challenges make it necessary to rethink research and the ways of educating researchers so that they can cope with them. We show that research has to be considered as skilled practice, consisting of numerous component skills which have to be trained so that future knowledge workers can successfully deal with unstable, uncertain and complex situations. As a practical application of this argument, we outline a project for an integrated Internet service, called BASES - Basic Support for Educational Study and Research.

1. Training researchers

It is not possible and, in fact, not sensible anymore to provide learners with pre-given answers to pre-defined generalized situations. What they rather need are the skills for investigating themselves the complex, new and uncertain situation they have to deal with. This kind of work is what is usually called "research", or, using a modern term, "knowledge work". This demand a radical re-thinking and re-design of teaching and learning, cf. e.g. (Schön, 1987; Schön, 1983).

Knowledge workers typically have to "consume" and "digest" information from widely varying, dispersed and uncategorized sources. They are being changed by information and seek to change others by it.
Changing context is characteristic of the situations knowledge workers have to deal with. Buckingham Shum (Buckingham Shum, 1997p.902) calls these situations "wicked problems", as they cannot be solved by known methods and pre-defined procedures. The process of identification and definition (or, as we would say: construction) of the problem is itself the main task at hand, requiring complex judgment and negotiation among the stakeholders. In this process of framing the problem, the goals, constraints and possible solutions change permanently, as does the need for and use made of information.

Research as a professional activity is, in our understanding, not restricted to the research professionals at universities and in R&E departments in industry, but rather a basic and essential skill for knowledge workers in the information society. But in our case we decided to specialize on educational research.

2. Research as skilled practice

Research work is neither an art that cannot be taught or learned, nor a set of rules and regulations to follow. It is a skill, or better a set of skills, that can be acquired (at least to a certain degree) and whose acquisition can be supported by training.

The mastery of a skill is not a question of "all-or-none": it is not the case that one day we are unskilled in a field and the next day we are experts. There certainly are steps and phases in the acquisition of skills, i.e. in the emergence of the capacity. Following the model proposed by Dreyfus and Dreyfus (Dreyfus, Dreyfus, 1986), who distinguished five steps in the process of passing from novice to expert, Baumgartner/Payr (Baumgartner, Payr, 1993) have outlined a three-dimensional heuristic model of teaching and learning with three different styles of teaching. These different teaching modes have important impacts of the adequate types of learning interactions:

FIGURE NOT AVAILABLE

Figure 1: Three-dimensional heuristic model of teaching and learning

The social perspectives and implications of these styles of teaching are substantially different. The knowledge transfer model is based on the belief that there exist people who know the right answer to a pre-defined question (e.g. the teacher). It is heir to a positivist tradition and corresponds to a hierarchical career model with competition at its center.

FIGURE NOT AVAILABLE

Figure 2:

The "situated learning" model, on the contrary, subscribes to the constructivist viewpoint where the coach collaborates with the learner to cope with a complex real situation for which neither of them has a ready solution. At the beginning of their concerted action, learners legitimately participate only peripherally (Lave, Wenger, 1991). During the learning process, their responsibility grows continuously until the learners can themselves act as coach for other, new learners.

The difference between commonsense knowledge and scientific knowledge is not the quality of knowledge itself. Both types of knowledge are structured experiences that one has to develop, acquire, examine and apply for a viable (successful) action. The quality of knowledge does not depend on the difference in range and object domain (Meehan, 1991). Scientific research develops (or should develop) knowledge in a systematic way and uses a meta-language (second order language) to describe the ongoing procedures and activities (Laurillard, 1993).

Whatever skill we want to train, we need a second order language which functions as a training language. The lack of a meta-language in scientific thinking is the biggest problem we have to confront in training research skills. The existing meta-language describes mainly the products of research but not the activity, the process itself. In training the knowledge worker, we find ourselves in a position where we can only judge if the product fulfills the scientific standards but not the skills that have to be improved. We are like football trainers who can only comment the outcome of a game, qualifying a won game as "good" and a lost one as "bad", without being able to specify what was good or bad, what should be improved and how this could be done. A prerequisite for training research is therefore to develop this meta-language, starting with identifying relevant actions and processes that make up the complex practice of doing research.

3. Training research skills with Internet support – BASES project

The logical consequence of this change for learning in context ("situated learning" (Chaiklin., Lave, 1993; Lave, 1991) is that the support for training these skills itself should make use of the new media that are able to integrate information, interaction and tools.

We follow this approach with the BASES (BAsic Support for Educational Study and Research) project, an Internet service for supporting and training research skills. It is the hands-on complement to a book on the subject that we are currently finishing. With BASES we support the training of research skills in three different ways:

a) *Cognitive Apprenticeship* (Collins, Brown, Newman, 1990): We provide different kinds and qualities of guided practice:

- general information and resources permanently updated and verified. These include links to libraries, grants; reviewed software tools (freeware or demo versions) for research work (e.g. mind-mapping software, bibliography packages); sample macros, stylesheets, forms etc.
- training modules for research-relevant Internet techniques (e.g. searching for and in online databases, assessing the quality of resources)
- interactive tele-learning modules with "human backing" for general research skills like research design, writing, argumentation, referencing.

b) *Anchored instruction* (Vanderbilt, 1990): Starting with common authentical problem situations, BASES offers a wide range of activities to tackle them:

- FAQ collections
- moderated and guided discussions
- online interconnections among users
- modular tele-learning courses for different authentical problems (how to limit the hits of search engines, how to quote Internet resources, ...)

c) *Cognitive flexibility theory* (Spiro, Jehng, 1990): Learning to defend different points of view and to take multiple perspectives:

- giving different examples of the same task (e.g. paraphrasing a certain quotation, constructing the same argument on different logical bases ...)
- defending different points of view (e.g. presenting the arguments of an author and of his/her critics, summarizing advantages and disadvantages of a certain procedure, product ...)
- choosing different methods on the same subject (taking a commonsense approach and a scientific approach, proposing a pragmatic and a theoretical solution, seeing a problem in short and long term development ...)

We call this integrated site for research support a service, not a server, because we acknowledge that it can only function optimally with "human backing". Beside the need for constant updating and for dealing with requests, problems, contributions and suggestions, there are different situations where support is necessary and new requirements arise. These could range from university teachers using the resources as complementary material for their courses to students who need a last-minute brush-up for presenting their thesis.

Making resources and training offers for research skills permanently available also addresses the need for learning on demand. Skills cannot be acquired on store and in one step, but require permanent training and refinement. With the help of BASES, learners can train their research skills whenever they need them and in unison with their growing competence and the increasing complexity of their research tasks.

Contrary to the book that we have been working on with little financial support, the design and implementation of the BASES service requires more personpower than we have available at the moment. The project is currently (End of October 1998) submitted to national funding program by the Austrian ministry of science. We are now shortlisted and have a final hearing in the middle of November in Vienna. We hope to start with the end of the year. A prototype of some of our ideas can be found under

http://www.uni-klu.ac.at/~pbaumgar/deutsch/medien/html/21.htm

4. Summary

Interconnected problems, rapidly changing unstable environments, and an indeterminate future of our society challenge our traditional education system. What is needed is not only factual and procedural knowledge for solving pre-defined problems but the active skill of framing problems, designing desirable changes and inventing ways to bring these changes about.

Research is not a gift based on "talent", "intuition" or "art" but a skilled social practice that can be learned and trained. What we need is a second order language for this training process that satisfies the following criteria:

- definition and isolation of different kinds of research skills and training of these skills
- development of a program to progressively chunk these different kinds of isolated skills to
- acquire a gestalt view of the research process
- integration of the challenges raised by new technologies in a self-study socio-technological environment.

We propose the BASES project as a small step in this direction.

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Telecommunications: Using Combined Technologies to Deliver Courses and Training--Lessons Learned from Montana State University-Bozeman Distance Learning Projects

Janis H. Bruwelheide, Ed.D.
Professor
Project Director, Montana University System Distributed Learning Pilot Project
Project Director, US WEST Montana Teacher Network
College of Education, Health, and Human Development
Montana State University-Bozeman
United States
janisb@montana.edu

Abstract: Three distributed learning projects involving various applications of telecommunications technologies are briefly discussed in this paper. The projects were conducted with Montana State University-Bozeman as the administrative and fiscal agent. Two of the projects were designed for higher education and both involved collaborative efforts. The third project was designed for k-12 teachers and involved peer coaching over 1300 Montana educators to use the Web and telecommunications in their classes.

Introduction

An article by Gibson and Gibson in *Adult Learning*, identified several lessons learned from over 100 years of experience with distance learning. Lesson one states that distance learning is different from that in the traditional classroom setting and traditional models should not be the base against which success or failure is measured. Lesson two stressed training for faculty, administrators, and support staff. Lack of training is identified as one of the biggest failures in distance learning. The third lesson is that learnersÆ needs must be continually supported during the learning experience.

Technology used effectively has the potential to link faculty and learners in order to overcome distance and to enhance sharing of institutional resources among units of the university system. Technologies can be used to reinvent the means by which instruction is delivered and the kinds of activities in which learners engage. Technology can assist in meeting increasing demands from potential learners who cannot afford to leave a job and/or family to pursue an advanced degree on a college campus.

These lessons serve as a framework to identify the multi-faceted issues in these projects. First, there is a need is to restructure and move faculty away from thinking that the traditional classroom model will work with distance learning. Second, it is necessary is to provide extensive faculty development and support for faculty so courses can be developed or adapted for appropriate distance learning formats and new teaching skills acquired and tested. Third, is the need to develop an adequate support system for learners who are engaging in distance learning activities and to enhance learner/faculty interaction. Finally, the impact that distance learning has on issues such as faculty work loads, salary, advising, promotion/tenure decisions, intellectual property concerns, and learner support must be determined.

Materials listed in the References and Web Resources section can provide readers with many additional considerations for designing distance learning courses and learning opportunities. There is much to consider in addition to a course itself. Institutions, faculty, and course designers must deal with intellectual property issues (copyright, patent, and trademarks) as well as technical support, library resources, faculty development, and student support. There are also many inter and intra institutional challenges which can make or break a course. In addition, there may be concerns from faculty and institutions about faculty rights, course ownership, and the effectiveness of distance learning courses. Inter and intra institutional issues which must be considered include application paperwork, registration fees and procedures, ease of registration, financial aid, transferability of courses, learner support and access to materials and library resources

This paper will briefly discuss three telecommunications distance learning training projects in the College of Education, Health, and Human Development at Montana State University-Bozeman and share some of the lessons learned as well as some of the challenges.

Telecommunications Faculty Development Project

During 1993, the first interactive television (compressed video) phase of the Montana Educational Telecommunications Network (METNET) was implemented and it consisted of compressed video codec (interactive television) units installed in four locations. This technology made available many distance education opportunities for delivery of course work, staff development, and videoconferencing which has previously been difficult. In order to demonstrate need and applications for the video network, courses and training had to be developed and delivered in order to convince the institutions of higher education, state offices, and the legislature that funding for additional sites should be continued. Officials of the Office of the Commissioner of Higher Education and the Telecommunications Division of the State Department of Administration were anxious to see demonstrations of educational applications between and among institutions. They also wanted to see demonstrations of the integrated use of the technologies with audioconferencing and Internet. To date, twelve sights are now operational and another video network, Visionet, has been installed due to a grant from the TIIAP program. It isnow possible to link to a medical telemedicine network and another video network installed in eastern Montana. Thus, the state is quite well covered with interactive television although communications costs are still relatively high. The METNET is very heavily booked with courses, training, and meetings. This project provided some early input and demonstration of effectiveness which has been shared with subsequent efforts.

Description of Project

The director was given the charge to design and deliver courses and staff development for faculty and teachers using the METNET technologies of compressed video and the bulletin board system during the 1993-1995 academic years at the Montana State University. Interested faculty were solicited and mini grants available for the design and delivery of courses or staff development using the system. Formative and summative evaluation was conducted with the idea of refining and learning as much as possible about instructional design for distance education courses and faculty development. This information was then applied by the director to future courses and shared with interested College faculty in the System. The Office of the Commissioner of Higher Education had established a goal of using telecommunications and distance education to facilitate intra institutional courses. The Montana State University (now the Montana State University-Bozeman) as a land grant university has a strong commitment to utilizing the METNET distance learning technologies for the State through course delivery to college students, K-12 students and lifelong learners as well as other applications.

Short Term Objectives

1. A faculty distance education resource person and possibly a cadre of faculty would be trained to use METNET and distance learning technologies as relevant to Montana. A "train the trainers" concept was used to facilitate program development and applications.
2. The METNET technology would be used to teach use of the system over the system.
3. Faculty from different higher education institutions would demonstrate a team teaching approach to a course using the network and possibly combining technologies.

Long Term Objectives

1. The METNET would become ingrained into education at all levels in Montana. The METNET interactive television system and bulletin board would be used as an instructional tool and conferencing tool by all three groups of users.

2. A well trained group of users would have developed a substantial amount of program applications materials for use on METNET.

3. The METNET would provide Montanans with opportunities for economic development and career options by workshops through Business, Extended Studies, degree granting and certification courses, licensing programs and various other activities.

Summary

The project proved to be very successful. The director designed and delivered the first two courses over the METNET to five sites including an onsite class at the Bozeman campus. At that time, the broadcast studio was primitive and presented many challenges for all concerned. The instructor had to run and manage the equipment while also teaching a live class to five sites. During the semester, some assistance was provided with camera support and the experience of managing the environment provided useful information about teaching a course over live television to the College as well as the Division of Extended Studies for Montana State University. It also provided information concerning teaching techniques and what types of additional equipment such as microphones, graphics camera, monitors, and furniture was needed as well as information about room arrangement and camera placement. During the second phase of the project, a course taught by instructors at two Montana institutions of higher education was designed and delivered. It dealt with telecommunications and was an experimental graduate course in teaching telecommunications using telecommunications. It used the interactive television network to deliver a weekly two-hour evening class and the campus computer networks were used for an online component to apply class content and complete assignments.

Several pieces of information were gathered from the project. Permission slips granting use of images were gathered from each student at sites where the course was delivered and students were informed that each class would be videotaped for research purposes. Each session of the course had a brief formative questionnaire administered which asked students a few questions about the nightÆs class. During the course of the semester, instructors experimented with varying the rates of transmission from quarter T1, and lower, to full T1 which at the time provided ônear broadcastö quality video. An interesting finding was that the students tolerated poorer quality video with no difficulty. However, they were insistent that the audio quality be excellent. Students were also sensitive to feeling involved in the class so that the instructors had to make sure that each class and student had a fair share of air time and that we learned their names. It was also important that remote students be sent materials ahead of time as they did not like to see the site with the instructor receive materials prior to them. Another interesting finding was that after the first session or two, students learned to ignore the technology. At one point, one instructor created a virtual computer lab using an audio conference for a remote site having trouble with a particular Internet navigation tool. It was surprising to find that the instructorÆs presence by audio with both she and the class looking at the same computer screen so that she could guide them through use of the tool was more important for student learning than using video without a hands on experience.

Other lessons learned from the project emphasized the intense early planning which must occur to prepare for a interactive television class delivered to several sites. Students must be able to receive course materials in a timely fashion and they must have a way to contact faculty by phone if something is not operative at the remote site. Having a way to contact remote students personally is important using traditional mailings as well as electronic mail is needed. Technical assistance for faculty and students was found to be an imperative. We also found that having a person at each site to handle the equipment and trouble shoot was also a necessity when funding allows.

Montana University System Distributed Learning Pilot Project

This project began during May, 1998 and was funded by a competitive, incentive grant from the Office of the Commissioner of Higher Education, Montana University System. The project involved designing and delivering five graduate education classes to be delivered through computer conferencing during the 1998-1999 academic year. Institutions involved were: College of Education, Health, and Human Development, Montana State University--Bozeman (administrative and fiscal agent); College of Education and Human Services, Montana State University--Billings; Department of Education and Graduate Programs; Montana State University--Northern; School of Education, University of Montana-Missoula.

To date, three courses have been delivered with two to be completed in May, 1999. Evaluation will be completed by June, 1999.

Objectives

1. A core of courses in the graduate MasterÆs Degree in Education was selected to be used as the focus for distributed learning delivery efforts in the College of Education, Health, and Human Development at Montana State University-Bozeman, the College of Education and Human Services at Montana State University-Billings, the Department of Education and Graduate Studies at Montana State University-Northern, and the School of Education at the University of Montana. Software used was the First Class Intranet Client housed on servers at the METNET and MSULINK, Burns Telecommunication Center at the Montana State University -Bozeman.
2. Through faculty development and support, it was hoped that faculty in these programs would collaboratively explore program design as well as adapt, design, and deliver courses suitable for delivery to distant learners.
3. Distant learners were to receive support regarding access to faculty, library resources, and information based on delivery of courses and services. Information gained and shared will further enhance and improve future offerings.
4. Coordination of course offerings would result in better distribution of programs in Montana and utilization of scarce resources.
5. Distant learners and faculty would benefit from a systematic, focused approach to course design and delivery.

Twelve faculty from the four institutions were selected to work on the project. A two day faculty development workshop was held at the Bozeman site in May, 1998, to begin work on the courses. An experienced, outside distance learning consultant was hired to work with the faculty in the workshop. Faculty received summer stipends to design and deliver the five courses during the academic year.

Challenges and Summary

This project has provided a lot of evidence which exposes inter and intra institutional challenges and obstacles to distributed learning efforts which need resolution before projects can proceed smoothly. The easy part was working with the faculty and students. Challenges included advertising, policies and procedures involving course registration, fees, transferability of courses and monies, and compliance with letters of agreement. Students using certain Internet service providers had difficulties using the First Class Intranet Client initially. The project also demonstrated some of the challenges in working collaboratively across institutional lines. Preliminary data from students shows a high degree of satisfaction with the courses and they felt that there was no lack of quality or rigor in the classes. Most students would have preferred at least one or two face to face meetings which could have been accomplished using interactive television or an on site session. Final evaluation of the project will become available in June and will be shared during the live presentation of this paper.

US WEST Montana Teacher Network

Challenges and Summary

Funded by a grant from US WEST and developed in cooperation with the Montana Education Association, an affiliate of the National Education Association, the Montana Teacher Network is currently providing peer coaching in telecommunications training and Web applications to over 1300 Montana Educators. The paper in the ED-MEDIA 99 proceedings on session 2483 provides information on the project so only a brief summary is included in this paper. The project involved distribution of notebook computers to an initial 132 teachers representing one percent of the Montana teaching force. The computers will remain with the teachers as long as they are teachers in Montana. Participants were selected through an application process and agreed to participate in an on site summer workshop, an online training course to be held during 1997-1998, and then to execute a training plan to peer coach at least ten colleagues during 1998-1999 thus impacting over 1300 Montana educators. The online course was conducted using First Class Intranet Client software housed on a server at the Montana State University-Bozeman Burns Telecommunication Center server. The second year of the project used the same software housed at the Montana Office of Public Instruction server for the METNET.

The project has been very successful and reports and anecdotes received from the coaches have been positive. They definitely see growth in their schools in using the Web and telecommunications. However, there have been challenges. One problem has been that some school districts were not able to provide the Internet access which was promised to participants selected for the project and this made it difficult for the teachers to fulfill their coaching requirement in a timely fashion. Four teachers were unable to complete the project and their notebook computers were recalled. It has proved difficult to keep track of the second group of teachers receiving the coaching. Having the ability to offer a credit option for the second wave of teachers would have been helpful but this proved to be impossible. Had it not been for the geographical challenges presented by the size and population of Montana, it would have been helpful to convene the teachers in groups two or three times during the project. Instead, the METNET bulletin board was used as the primary gathering place. Plans are underway to continue the Montana Teacher Network and expand it to a community approach. Additional funding and partnerships to take the project forward into 2000 are being sought.

A Few Ideas to Consider When Planning Distributed Learning Projects

1. Conduct a needs assessment to determine the target population and consider the needs of the group including level of technology literacy.

2. Determine who are the stake holders in the project and their agenda.

3. Decide in advance how to distribute instructional materials and obtain copyright clearance and permissions when needed.

4. Select the technologies to be used and consider a combined approach

5. Consider all financing aspects and any hidden costs.

6. Determine whether courses will be in-load or taught for extra pay.

7. Consider all possible policies and procedures which might impede the project.

8. Determine how faculty and remote learners be supported.

9. Determine how the course and effort will be evaluated for feedback as well as promotion and tenure considerations.

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Web Resources

American Distance Education Consortium
http://www.adec.edu/

Distance Education Clearinghouse
http://www.uwex.edu/disted/home.html

Journal of Library Services for Distance Education
http://www.westga.edu/library/jlsde/

Western Cooperative for Educational Telecommunications
http://www.wiche.edu/telecom/telecom.htm

Multimedia for Teachers

Marjan KRASNA, D.Sc.,
Center for computer science and multimedia in education,
University of Maribor,
Faculty of Education,
Slovenia - si
marjan.krasna@uni-mb.si

Ivan GERLIC, D.Sc.,
Center for computer science and multimedia in education,
University of Maribor,
Faculty of Education,
Slovenia - si
ivan.gerlic@uni-mb.si

Abstract: To establish a new studying course extensive researches have to be done. Government of Slovenia - Ministry for Education and Sport sponsored the research for the new studying course "Multimedia for Teachers". Fundamental research was conducted to verify positive effect to the learning process. Research of written materials and know-how of similar projects was done to define objective of the project. Later the project plan to implement the studying course was made and; verification of the project plan was not left out. The project is now at the beginning of the implementation. First populations of students - future teachers are experience new approach to the teaching by learning multimedia with computers.

Introduction:

The research projects to find potentials of the multimedia in various branches of enterprises were conduct a long time before the technology was available at acceptable price. In the 90's technology becomes available. Now is the time to use the results of research projects once conducted and research of the things that were not apparent till now.

Government of Slovenia - Ministry for Education and Sport funded the project to improve computer technology at primary and secondary schools named RO (Computer Literacy). As the schools get better equipped teacher was educated to use the potential of equipment. One of the five strategic research subprojects in project RO is "Multimedia in Education". In the research work for a project "Multimedia in Education" three parties are involved: Republic of Slovenia - Institution for Education and Sport, Faculty of Computer Science in Ljubljana and Faculty of Education in Maribor.

Using statistical analysis of the gathered data it becomes clear that multimedia in the teaching process increases effect of learning. By combining the entertainment and education the pupils finds fun in absorbing the educational material and the time necessary to remember the certain information was significantly shorter in compared with the traditional educational materials.

We were not satisfied with results of statistical analysis. In the search for artifacts that would clearly support the statistical analysis we started fundamental research of effects of multimedia material to the brain activity. It was found that a larger portion of the brain is active if multimedia educational material is used (Jausovec, 1998). Statistical analysis was confirmed.

The new step was taken to study the market available multimedia supported educational materials. The majority of these materials is in English language and not always suitable for use in the primary and secondary level of education. There are doubts if these materials can be used in the large scale even at the university level. The conclusion is simple. We need to prepare the multimedia supported educational material in such a way to be easily translated to any language.

As a test the multimedia supported educational material for the physics was prepared. The users very well accepted these educational materials. Using this material we find that the most appropriate media for distribution is CD-ROM. The bitrate of current communication network does not allow Internet distribution. Materials have large amount of video clips and can be use on LAN but is almost impossible to transmit them to students'

computers over telephone lines. On the other hand we are also members of European project COLOS (see COLOS) where the interactive computer materials is accessible over the Internet.
When we gain experience we find out that teachers have to be prepared to use this material as a valuable support in their work. This is the goal of the project "Multimedia for teachers".

Project Goal:

Curriculum:

Subject: **MULTIMEDIA**
Time span: 60 hr; 30 hr lectures, 30 hr practical experiments
Year: 2. or. 3.

Goals:

Students will:

- become aware of the importance of mono/multimedia system in education;
- become aware where and how they can use mono/multimedia systems in their work;
- get qualified and motivated for creative problem solution in primary and secondary schools using mono/multimedia systems;
- get qualified for use of mono/multimedia system during their studying and research & development activities.
- get acquainted with methods and rules for making of simple mono/multimedia systems in their classes and basic laws of special didactics for that field.

Contents:

1. *educational technology basics*: terms, classification, history, mono/multimedia in education;
2. *monomedia systems*: technical didactical characteristics of visual and audio monomedia systems;
3. *application of computer in education and educational information system*: cybernetics, systems theory, information theory, communication theory, information systems;
4. *multimedia systems*: terms, classification, history, technical didactical characteristics of multimedia elements/systems and;
5. *planning the appliance of mono/multimedia system in education.*

Project Plan:

IMAGE NOT AVAILABLE

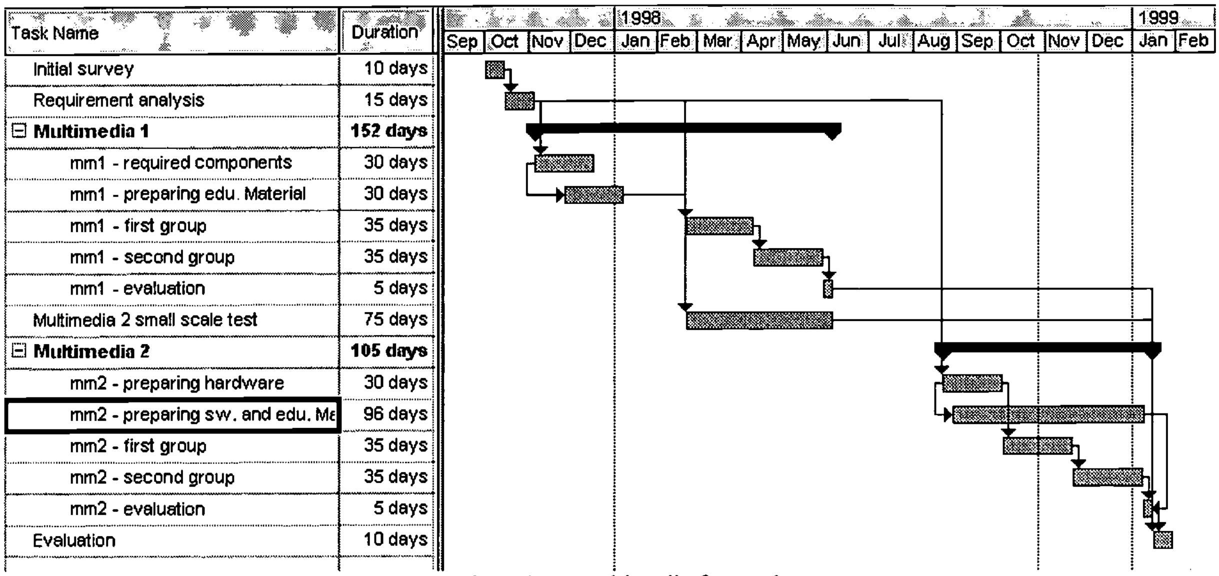

Figure 1: project plan - multimedia for teachers

Description of the Plan:

In the "*initial survey*" we gain the agreement of the different participants of the project. It was decided to separate multimedia into two courses. First course "Multimedia 1" would gives students initial knowledge to the traditional multimedia systems (radio, CD players, cassette recorders, minidisks, TV studio equipment, VCR's, camcorders, presentation techniques). The student course having elements of multimedia 1 was held even before. It was called "*Educational technology*". Now it was reorganized and renamed into multimedia 1. The second course "Multimedia 2" would extend students knowledge to the computer technology. Objective for the project is two level of knowledge. In the lowest level students would learn what the new technology is capable to do. In the highest level students would be capable to fully utilize the new technology. With these levels we provide individualization and differentiation.

In the "*requirement analysis*" we were to make a rough list of required equipment, hardware, software and educational material for each of the working place. Most of the traditional multimedia systems were already presented at the faculty but computers were not. The project could easily be jeopardized if we could not gain enough funds to equip a new computer multimedia room. It was decided that no previous knowledge would be required for course "Multimedia 1" but for course "Multimedia 2" a knowledge of use of computers operating system (MS Windows); wordprocessor (MS Word); presentation program (MS PowerPoint) and; Internet browsers would be required. Education material for the "Multimedia 1" would be prepared; printed and put to every working place but for the "Multimedia 2" education material and descriptions for every working place would be on the Internet. We were capable to do this since every working place would have a computer connected to the Internet.

The phase "*Multimedia 1*" was divided into several tasks. The first task "*mm1 - required components*" was to establish the working places; put equipment to that working places and; check how things work. It also includes the detailed learning of tutors how to use every single equipment. When task "*mm1 - required components*" starts we could start second task "*mm1 - preparing edu. material*". Education materials were consist of manuals; description of the working place and required work to do at the specific working place.

"*mm1 - first group*" and "*mm1 - second group*" are tasks where Multimedia 1 becomes operational. 429 students in the second year passed this course. Informations we get from them were satisfying. Most of the students really enjoyed working with audio, video and presentation equipment.

At the same time we start with elements of Multimedia 2 - "*Multimedia 2 small scale test*". The test group was the students of computer and mathematics teachers' course. We got valuable responses from them what can we expect from other students. They help us prepare better educational material and establish the working places.

In the task "*mm2 - preparing hardware*" not only computers needs to become operational. A new LAN with UTP technology has to be made and furnished the whole room. The task "*mm2 - preparing sw. and edu. material*" takes a lot of time because preparing web pages with instructions and lectures takes a lot of effort. (Ambron, S.,& Hooper, K. 1990), (Bergman, R. E., Moore, T., V. 1991), (Frater, H.,& Paulissen, D. 1994), (Gerlic, I.

1991), (Jereb, J.,& Jug, J. 1991), (Tauber, H. 1993), (Wodaski, R 1992). Now we are at the point where first student group are learning multimedia with the computer.

Description of Multimedia course

It was easy to establish first part of multimedia course "Multimedia 1". We have many years of experience with similar course "Educational technology". Preparing students to the course "Multimedia 2" was primary objective of course "Multimedia 1". Most of the students have sufficient level of knowledge even prior attending this course and most of them just love working with the latest technology. For most inquisitive students we also have video studio equipment. Students have to pass through every working place except video studio.

Multimedia 2 was completely new course. We had skilled personnel but no experiences with students for this course. Preparation of working places and working instructions required paramount attention. Everything was designed to be easily changed. Now we could increase or decrease required work in a matter of hours. Since everything is accessible on the Internet and students can prepare themselves before they actually come to work with equipment.

We will explain procedures of course "Multimedia 2" in more details. The course "Multimedia 2" has nine working places. Attending students have instant help from assistant and technical support person. Students are encouraged to pass through as many working places as they can during their course.

Description of working places:

- three are for processing audio signals (CD, tape, radio, voice, Internet ...);
- two are for image processing (scanning, digital photography, retouching, OCR ...);
- one is for animation (GIF, AVI, MPEG ..);
- one is for Internet (searching for multimedia web sites, educational software, downloading, installing, writing manuals for downloaded programs, ..);
- one is for video capturing and;
- the last one is for presentation (PowerPoint, DVD ...).

Problems

One of the greatest problems we encounter was the required knowledge of using a computer. Students should gain required knowledge in the secondary schools but in reality we find out that this is not true. Since every student have free access to faculties computes (Internet; e-mail account and; PPP) we assume that they will use these services. We were wrong. Faculty of Education has a lot of different student programs. We have to teach them all. We were aware that students from natural sciences programs would easily accept computer as a working tool than the other students. In order to solve the problem we have to remake the lessons and make them in such a way that it would satisfy diversities.

We also have a problem in the system itself. Special didactics course (didactics of physics, didactics of geography ...) does not prepare students for new technologies. Students are unaware of importance of multimedia educational material. To overcome this problem we need to change the way people think.

Among other problems we also face software problem when we find out that Slovenian Windows are not completely compatible with English version. We could not use Volume Control to change any settings of the sound card. Any attempt was stopped with error message and Volume Control termination. We solve this problem by installing English version of Windows.

Future plan

Our future plans are:

- making multimedia learning material to be used by students and teachers in primary and secondary schools;
- establish multimedia advisory service for primary and secondary schools;
- establish standards and quality control for multimedia education material;
- lobbying for improving national/university computer network to advanced high bandwidth computer network;

- establish multimedia student program;
- establish university on demand TV;
- establish connections with other universities and improve students and lecturers mobility and;
- we will be open minded.

Conclusion

In today's modern world we cannot allow time to pass by. Learning must become more effective and multimedia is the answer. So future education cannot be without multimedia. As this is true a lot of work needs to be done to produce enough multimedia educational material for every program and every course. Constant education of teachers and students is essential for this to become true. Multimedia education material and high bandwidth network must be accessible to every interested individual.

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Frater, H.,& Paulissen, D. (1994) *Das grosse buch zu MULTIMEDIA*, Data Becker, 1994
Gerlic, I. (1991) *Basics of Computer in Education,* Maribor, Faculty of Education, 1991 (*in Slovene language*)
(*original: Osnove ra unalništva v izobra evanju* . Maribor: PeF, 1991.)
Jereb, J.,& Jug, J. (1991). *Educational Technology in Education,* Kranj, Faculty of Organizational Sciencies, 1991 (*in Slovene language*)
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COLOS - COnceptual Learning Of Science - URL: http://sunsite.fri.uni-lj.si/~colos/
Confederation College, Thunder Bay, Ontario, Canada
http://alpha.confederationc.on.ca/programs/calendar/bumulti.html

Intellectual Property and Copyright : Ideas for Managing Issues and Protecting Educational Interests

Janis H. Bruwelheide, Ed.D.
College of Education, Health, and Human Development
Montana State University-Bozeman
United States
janisb@montana.edu

Abstract: How do we create an innovative, supportive environment for teaching and learning in an electronic environment while attending to copyright and intellectual property concerns especially considering recent changes made to copyright law in the United States? The subject of intellectual property is one of importance to individuals involved in all aspects of Internet and Web based education globally. This session will set forth some intellectual property concerns and issues for faculty and institutions and suggest policy and content and audit points for consideration and discussion.

Introduction

The electronic environment is forcing educators at all levels to revisit issues concerning intellectual property. Quick availability of information and data electronically has changed the way the general public views information since it is in seeming less endless supply on anyone's desktop. Thus, faculty and students alike are faced with a figurative smorgasbord of materials in varied formats. A dilemma concerning intellectual property occurs when owners' rights collide with users' rights and the public need to access and use resources. Thought provoking papers about the Internet and intellectual property are becoming available on the World Wide Web. Esther Dyson has written a book, Release 2.0, and several articles dealing with intellectual property on the Internet and the intellectual value of property. An article by Vincent J. Roccia presents an interesting perspective on copyright law in the United States and possible changes or clarifications needed perhaps to enhance applicability to the Internet. Current copyright laws in the United States perhaps do not quite address the Internet per se because it represents a challenge to existing law and interpretations.

This paper will present a brief overview of several topics. The first is ideas and concerns as to why faculty and institutions in education, particularly higher education, have good reasons to ask questions concerning "who owns what" in a era where educational opportunities may be delivered through the World Wide Web and various distributed learning systems. Secondly, it will present issues relevant to learner support and student ownership. Lastly it will present sources of information, and sample policies, as well as ideas about ownership of intellectual property which institutions might consider. A copyright update for 1999 will be an inclusion of this brief paper on intellectual property concerns and issues. These issues include highlights of Digital Millenium Copyright Act signed into law in October, 1998, new provisions for library preservation copying, and distance learning guidelines currently under study by the Register of Copyrights.

Institutional and Faculty Concerns

Distribution mechanisms, format of materials, and traditional models of ownership are bringing increasing concerns about intellectual property development, use, and application to a new importance in academic conversations. University professors, under the old way of viewing ownership, were the single owners and authors of intellectual property with a few exceptions. However, in today's environment, ownership may be shared with several individuals or organizations as new technology encourages development of multimedia products using a variety of formats and pieces which may involve multiple layers of copyrighted materials.

The dilemma of "who owns what" is compounded when one considers matters such as how much support, use of facilities, and equipment involvement are used to produce a work using newer electronic technologies. Often the institution has invested a great deal of funds in a project or product before it is used for educational purposes. The author believes that basically four major issues concerning intellectual property need to be addressed by faculty and institutions through dialogues, policies, and communication:

1. Ownership of intellectual property
2. Rights to use intellectual property
3. Procedural issues concerning intellectual property
4. Special considerations concerning copyright

In most cases, an "audit" or checklist of what rights need to be acquired, cleared, or considered must be developed prior to design, production, and delivery of a course, for example, through the World Wide Web or through other distance learning distribution systems. Institutional personnel should think through what rights are needed for a course and what all future possible uses and distribution mechanisms of course content might be prior to release. If not accomplished prior to development, the entity could find itself having to retrace steps and renegotiate or acquire additional rights at more cost. Thus, planning ahead with a checklist approach could save a great deal of money, effort, and hassle for all involved.

Some authors and organizations have made information available which can encourage and guide discussions about intellectual property in the higher education environment. Many professional associations are discussing the issues but no definitive checklist or statement exists currently since ultimately each institution must deal with the volatile topic of intellectual property and issues concerning "who owns what" at the state or local level. A few examples of resource materials are included at the end of this paper. An interesting document entitled Ownership of New Works at the University: Unbundling of Rights and the Pursuit of Higher Learning by the Consortium for Educational Technology for University Systems, CETUS (www.cetus.org), suggests several points worth considering in a discussion. The group sets forth a viewpoint that simple, individual ownership of all rights which are associated with copyright may not now be the most desirable avenue as it may stifle creativity and new work unduly. Thus, it is time for higher education to revisit ownership of intellectual property in order to avoid contention, place the focus on optimal access and development of works, and reduce the emphasis on economics which often dominates discussions about intellectual property. CETUS sets forth the "three C approach," to conversations about intellectual property: creative initiative, control of content, and compensation concerning published as well as unpublished works. The approach is quite useful as it may be less intimidating and antagonistic than beginning with the economic issues and may apply more broadly to faculty engaged in producing materials but not necessarily receiving compensation for those materials.

The CETUS model for discussion, the "three C approach" presents the following points. The first point is creative initiative and poses discussion questions such as "who generated the idea for the work, whether published or unpublished, and who created the work and fixed it in a tangible medium? For example, a Department Chairperson might encourage faculty to publish but not dictate the ideas and content. The entities of initiator, creator, and fixator may not be the same. The second point for discussion deals with the control of content as to who controls creation, production, specifications, and authority for acceptance. The degree of control is something which might be negotiated. The third point is compensation and other support. The CETUS document suggests that unless the two were extraordinary--above what faculty are normally provided-- the faculty would most likely retain ownership of intellectual property they created. Again, there are many areas of negotiation under the third discussion point.

Another way of approaching ownership of intellectual property is presented in a paper by Dan L. Burk, an attorney and Associate Professor of Law at Seton Hall University. He presents a good overview of models for copyright ownership of electronic course materials between faculty and their sponsoring institutions. is paper presents detailed discussion of advantages and disadvantages of three sets of options and two models which might be considered by universities and colleges drafting documents for copyright.

Bruwelheide presents in her writings several issues concerning intellectual property and some materials specifically targeted to copyright, telecourses, and Internet.

In summary for this section, it is important for universities, colleges, and faculty to engage in dialogue concerning intellectual property so that ownership issues are clearly defined before products are developed by institutions, faculty, and even students. There is plenty of room for negotiation but faculty must be informed about policies and participate in the development. If not, both faculty and institutions stand to lose a great deal. Creation of new intellectual property is very important and the climate must be supportive for both sides.

Student and Learner Support Issues and Concerns

Students' rights to ownership of intellectual property they develop while students or student workers at a college or university need to be considered in addition to rights of faculty. In some instances, universities and colleges lay claim to all work produced by students. This issue needs to be addressed by institutions, policies developed, and ways found to inform students as in the catalogs for the institutions.

Learner support issues for courses delivered via distributed learning technologies bring new concerns to the discussion table. Included are topics such as electronic reserves for libraries and housing of course syllabi and materials on a university computer network. The author presents questions such as the following:

1. What rights need to be acquired and cleared prior to posting course materials including syllabi and readings on a closed versus an open network? The same question applies to courses delivered via the World Wide Web and other distributed learning networks such as video conferencing.

2. Is an online class treated the same or differently than a traditional "face-to-face" class when it comes to copyright issues? Many institutions are treating an online class such as one delivered via the Web or through computer conferencing software as a closed class which must be password protected. Thus, only students actually enrolled in the class could access materials with a password and not much material could be seen by non enrolled individuals.

3. What about posting student work to a class web site? It would seem certainly that clearances would have to be obtained from the students.

4. May students freely use materials they find via the World Wide Web for class projects? Does the format make a difference or are formats such as music, video, and graphics to be treated differently than print materials?

5. May library personnel scan articles for online class reserve systems? If so, must the network be closed except through students enrolled in a specific class?

Closing Statement

This paper has set forth some ideas to provoke discussion and perhaps policy development for intellectual property issues, particularly copyright, which need to be addressed by institutions of higher education and faculty in order to maintain the flow of good materials in a changing electronic environment. Failure to discuss and address these issues may result in a curbing of creativity and much antagonism on the parts of faculty and their institutions. Many models and points for discussion exist which can lead to successful negotiation of ownership issues.

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Roccia, V. (1997). What's fair is (not always) fair on the Internet. *Rutgers law journal*, 29 (1).
http://www-camlaw.rutgers.edu/publications/lawjournal/rocciahtm.htm

Thompson, Dennis P. (1999). Intellectual property meets information technology. *Educom Review.* 34 (2), 14-21.

Resource List

Materials dealing with intellectual property globally are abundant and quite easily located via the World Wide Web. The materials selected for inclusion in this list are by no means comprehensive and the list is not exhaustive. Sites were selected because they provide unique information and/or links to many additional resources on a variety of intellectual property topics issues, and perspectives. Readers may follow links in the resources to obtain more information. While the primary focus is on USA resources, some urls are provided for international perspectives and have links to hundreds of sites. Sources are current as of mid-1999.

World Wide Web Source List

Consortium for Educational Technology in University Systems: CETUS Discussion Series
http://www.cetus.org

Copyright Crash Course, University of Texas
http://www.utsystem.edu/OGC/IntellectualProperty

Copyright Management Center: Indiana University-Purdue
http://www.iupui.edu/it/copyinfo/

Copyright Office, Library of Congress:
http://lcweb.loc.gov

Fair Use Center
http://fairuse.stanford.edu

Sample Intellectual Property Policies in the United States

Carnegie Mellon:
http://gollum.mac.cc.cmu.edu/univ_policy/documents/IntellProp.html

Copyright Resources Online:
http://www.library.yale.edu:80/~okerson/copyproj.html

Copyright Resources Online -- Policies
http://www.library.yale.edu:80/~okerson/copyproj.html#ucopy

Johns Hopkins Medical School:
http://cwis.welch.jhu.edu/policy/intellectual_prop_guide/som_intpol2.html

University of Massachusetts:
http://woods.uml.edu/www/telecom/TADS/tadsfwc.html

Library Issues

Electronic Scholarly Publication:
http://www.arl.org/transform/esp/index.html

Electronic Reserves:
http://www.research.umbc.edu/aok/reserve.html

Faculty Guidelines:
http://www.lib.umich.edu/libhome/Reserves/faculty/faculty.html

Liblicense:Licensing Digital Information:
http://www.library.yale.edu/~Llicense/index.shtml

Licensing:
http://www.arl.org/scomm/licensing/licbooklet.html

International Intellectual Property Sources

Digital Future Coalition
www.dfc.org

Electronic Freedom Foundation
http://www.eff.org/pub/Intellectual_property/

European Commission Legal Advisory Board Intellectual Property
http://www2.echo.lu/legal/en/ipr/ipr.html

Franklin Pierce Law Center:
http://www.fplc.edu/ipmall/pointbox/pb_intr.htm

Intellectual Property: Copyright and Intellectual Property
http://www.nlc-bnc.ca/ifla/II/cpyright.htm

Intellectual Property Law World Wide
http://www.ipww.com/index.html

Public Policy Issues Related to Intellectual Property
http://www.essential.org/cpt/ip/ip.html

World Intellectual Property Organisation - WIPO
http://www.wipo.int/eng/index.htm

World Trade Organisation - WTO
http://www.unicc.org/wto/Welcome.html

World Wide Web Virtual Library: Law : Intellectual Property
http://www.law.indiana.edu:80/law/v-lib/intellect.html

AN ANALYSIS OF INTERNET-BASED COMMUNICATION AND COLLABORATION AMONG K-12 TEACHERS

Barbara Ohlund, Instruction and Research Support, Arizona State University, USA, barbara@earthvision.asu.edu
Angel Jannasch-Pennell, Ph. D., Instruction and Research Support, Arizona State University, USA, angel@asu.edu
Samuel A. DiGangi, Ph.D., Instruction and Research Support, Arizona State University, USA, sam@asu.edu
Sandra Andrews, Instruction and Research Support, Arizona State University, USA, ozma@asu.edu
Chong Ho Yu, Ph.D., Instruction and Research Support, Arizona State University, USA, alex.yu@asu.edu

Abstract: This study investigated the use of asynchronous (mailing lists) and synchronous (chat sessions) Internet-based communication and its impact on teachers' attitude toward collaboration, activity completion rate and test performance. Although in this study it was found that attitudes toward collaboration did not affect test performance, the data suggested a relationship between attitudes toward collaboration and use of Internet-based communication. Also, it was found that use of Internet-based communication increased the likelihood of completing the course activities.

OBJECTIVES

Cognitive models of learning stress that learners are active agents in constructing their own learning (Shaw, 1995; Biehler & Snowman, 1986). Asynchronous and synchronous communication provides users with opportunities to collaborate across distances through such technologies as mailing lists and chat sessions, respectively. It was hypothesized that these modes of communication provide unique features conducive to the development of a collaborative community of learners. The benefits of Internet-based communication and collaboration are not reflected solely in test performance. Behind the behavioral change is an attitudinal change. Gain in test performance might be short term; change in attitude could facilitate life-long learning (Yu, 1998). Therefore, this study investigated the use of asynchronous (mailing lists) and synchronous (chat sessions) Internet-based communication and its impact on teachers' attitude toward collaboration, activity completion rate and test performance.

THEORETICAL FRAMEWORK

Several theoretical perspectives suggest that peer interaction occurring in computer networked groups may be beneficial to learning. These perspectives include Vygotsky's (1978) and Piaget's (1963) emphasis on social construction of knowledge and Bandura's (1969) interpretation of peer modeling (King, 1989). From a social cognition point of view, when educators interact with peers they are faced with ideas, explanations and information inconsistent with prior knowledge and beliefs. Confronting these inconsistencies challenges one's current point of view; resolving such cognitive conflicts results in cognitive restructuring (Bearison, 1982). Group members presumably add detail to existing cognitive schemas, explore and correct misunderstandings, fill in gaps in their knowledge, and/or reorganize their knowledge structures (Bearison, 1982; Piaget, 1963; Vygotsky, 1978).

Collaborative learning is the acquisition by individuals of knowledge, skills or attitudes as a result of group interaction, where that specific learning could not have been derived individually (Schrage, 1990). Computer-mediated collaboration provides a medium for educators to learn to engage in collaboration with other educators at a distance. Alavi (1994) observes that those involved in collaboration can monitor individual thinking, opinions and beliefs and provide feedback for clarification and change.

Internet-based communication provides both asynchronous and synchronous environments for collaboration. Synchronous communication (such as chat) allows interaction to occur at the same time among learners, as in classroom discussions: but learners in the Internet environment use a keyboard to type messages. Local Internet accounts enable learners to engage in collaborative chat sessions with distant peers, expanding the collaborative environment from a single classroom to classrooms around the world. Asynchronous communication (mailing lists) allows interaction to occur at different times and locations between two or more learners. Learners need not be present to receive information, and may communicate when ready. Learning occurring as a result of group interaction may take place in a virtual community and may be adjusted to student need, schedule and educational goals. Both of these forms of Internet-based communication expand learners' access to information, resources, and collaboration, and may increase learners' attitude toward collaboration as well as achievement performance. In this study, we are interested in both forms of Internet-based communication as they relate to learner attitude toward collaboration and the completion rate and performance on Internet skill tests.

HYPOTHESES

Based on the above theoretical framework, the following hypotheses were formed:

(a) Use of Internet-based communication increases teachers' positive attitude toward collaboration on the Internet as measured by the *Stages of Concern Instrument: Attitudes Toward the Internet* (*ATI*; Hall, George, & Rutherford, 1977; Well and Anderson, 1997);
(b) Use of Internet-based communication increases course completion rate;
(c) Use of Internet-based communication increases test performance as measured by criterion-referenced Internet skills test;
(d) The more positive teachers' attitudes toward collaboration, the higher the increase in teacher performance as measured by criterion-referenced Internet skills test; and
(e) The more positive teachers' attitudes toward collaboration, the higher the course completion rate.

METHODS

PARTICPANTS

Participants in this study were one hundred sixty-one K-12 educators residing throughout a southwestern state. All participants took part in an interactive web-based course designed to enhance the collaborative teaching and learning communities for participating educators as they acquired Internet skills.

TREATMENT

The treatment was an interactive web-based course designed to enhance the collaborative teaching and learning communities for participating educators as they acquired Internet skills. Of particular interest were new outcomes made possible through use of advanced technologies in instruction. Therefore we looked at the engagement in Internet-based communication and increases in Internet skills.

PROCEDURE

Participants were part of a large collaborative community (the course) as well as of smaller communities focused on establishing professional relationships and on technical and course help. These smaller communities were facilitated by a group leader trained in the use of Internet technologies and in how to facilitate Internet-based communication. Participants had access to chats and were members of two course-related mailing lists, (a) course announcements, and (b) a group list headed by the group leader. Group leaders conducted at least one chat bimonthly and communicated with their participants via group mailing lists biweekly. Participation in chats was mandatory for group leaders and strongly encouraged for participants. Participants were encouraged to join other mailing lists within the course setting as well as outside of the course. Archives of eleven chat sessions and eleven mailing list groups were used in this investigation. The Internet skills that participants were to learn focused on searching techniques and the use of email. Participants completed a pretest assessing their Internet skills in these areas. Following the pretest, participants completed tutorials specific to these skill areas, then completed a posttest.

DATA COLLECTION

Two instruments were employed in this study. The first instrument was the *Stages of Concern Instrument: Attitudes Toward the Internet* (*ATI*; Hall, George, & Rutherford, 1977). This scale was developed to measure the evolving attitudes of learners exposed to an innovation. In this original scale, the variable word "innovation" may be substituted with the innovation of interest. Therefore, in a study regarding learner attitudes toward a new innovation, specifically the Internet, Wells and Anderson (1997) substituted the variable "innovation" with "Internet" to measure attitudes toward the Internet. Reliability of the instrument was reported as .91 (Reed, 1990), and discussed in detail by Wells and Anderson (1997). The second instrument was a performance test over the Internet skills learned that was developed by our research team. For both measurements, a pretest was administered prior to a web-based instruction program. Three months later a posttest was given. The interval was short in order to avoid the "maturation" effect in which subjects improve over time regardless of treatments (Cook & Campbell, 1979). All participants completed the pretest and 95 finished the posttest. One hundred and fifty-nine participants completed the ATI survey and fifty-six completed the post-survey.

A subscale of ATI was used to measure the attitude toward collaboration though the entire survey was administered to the participants. The survey was composed of 35 questions and could be divided into seven subscales, which indicated seven stages of concern with the Internet. The seven stages were awareness, informational, personal, management, consequence, collaboration, and refocusing (Wells & Anderson, 1997). Please see Table 1 for the items in the collaboration subscale.

Question 5:	I would like to help other faculty use the Internet.
Question 10:	I would like to work with present fellow workers and others who are using the Internet.
Question 18:	I would like to familiarize my colleagues about the Internet as I learn more about it and with it more.
Question 27:	I would like to coordinate my efforts in learning about the Internet with fellow workers.
Question 29:	I would like to know what other people are doing in relation to the Internet.

Table 1: Collaborative subscale in Stages of Concern Instrument: Attitude Toward Using the Internet

Factor analysis confirmed the factor structure of the instrument. Based on the pre-survey data, the survey items could be grouped as eight latent variables according to the Kaiser criterion (eigenvalue as one or larger). By examining the inflection point in the scree plot, seven factors could extract most of the eigenvalues. In the post-survey, Kaiser criterion also suggested eight factors while the scree plot implied five to seven factors.

Based upon the pre-survey data, the estimated reliability of the entire ATI survey in terms of Cronbach coefficient Alpha was .86 whereas the Cronbach coefficient Alpha for the collaboration subscale was .87. In the ATI post-survey data, the overall Alpha was .89 while the collaboration subscale Alpha was .79.

The second instrument in this study was a criterion-reference performance test, which consisted of 30 items. Cronbach coefficient Alpha of the pretest was .45 whereas that of the posttest was .86. The low Alpha in the pretest, which was expected, implied that participants were unfamiliar with the subject matter and random guessing of answers led to inconsistency. In the posttest the high Alpha denoted that the response pattern was internally consistent.

Finally, use of mailing lists and use of Internet chat were logged as a measure of engagement in Internet-based communication as a collaborative tool. Originally, engagement in collaboration was defined by the number of words in email/chat and the total number of messages. However, these distributions were highly skewed and thus violated the assumptions of parametric tests. Therefore, observations were re-coded into four binary variables: (a) use of mailing lists, (b) use of chat sessions, (c) use of both mailing lists and chat sessions, and (d) use of neither mailing lists or chat sessions.

RESULTS

Prior to addressing the hypotheses, two one-tailed dependent t-tests were employed to examine whether improvement in teacher scores on the Internet skills test and the ATI collaboration subscale occurred after the treatment. The dependent t-test for the difference between the pretest and posttest yielded a significant difference, $\underline{t}$

(94) = 16.33, p = .0001. Given that the effect size was .03, the alpha level was .05, and the sample size was 95, the power for this t-test was .90, which indicated a high probability that the null hypothesis was correctly rejected.

On the average participants had a decrease in the positive attitude toward collaboration after the treatment, M = -0.67. A dependent t-test showed that this decrease was not significant, t (42) = -0.88, p = 0.38. This result might be due to the lack of statistical power. Given that the effect size was .03, the alpha level was .05, and the sample size was 43, the power for this t-test was .61, which indicated that a true significant difference might be undetected.

To test the hypothesis regarding the relationship between engagement in Internet-based communication and attitude toward collaboration (hypothesis a), exploratory data analysis instead of ANOVA was performed to examine the relationships. The data structure did not conform to the parametric assumptions of ANOVA such as normality and homogeneity of variances, and this sample size was not large enough to run a robust ANOVA test. In the exploratory data analysis, it was found that users of chat and mail tended to center around the mean of the difference between collaboration pre-survey and post-survey, as shown in Figure 1. Participants who engaged in chat sessions had less variability on the change score of ATI (-7.5 to 1.5) than the general test population. Likewise, participants who posted messages on mailing lists also centered around the mean (-4.5 to 4.5). Therefore this might indicate that participants who engaged in chat sessions or mailing lists have less change in their attitude toward collaboration than those in the general test population, maintaining scores close to the mean.

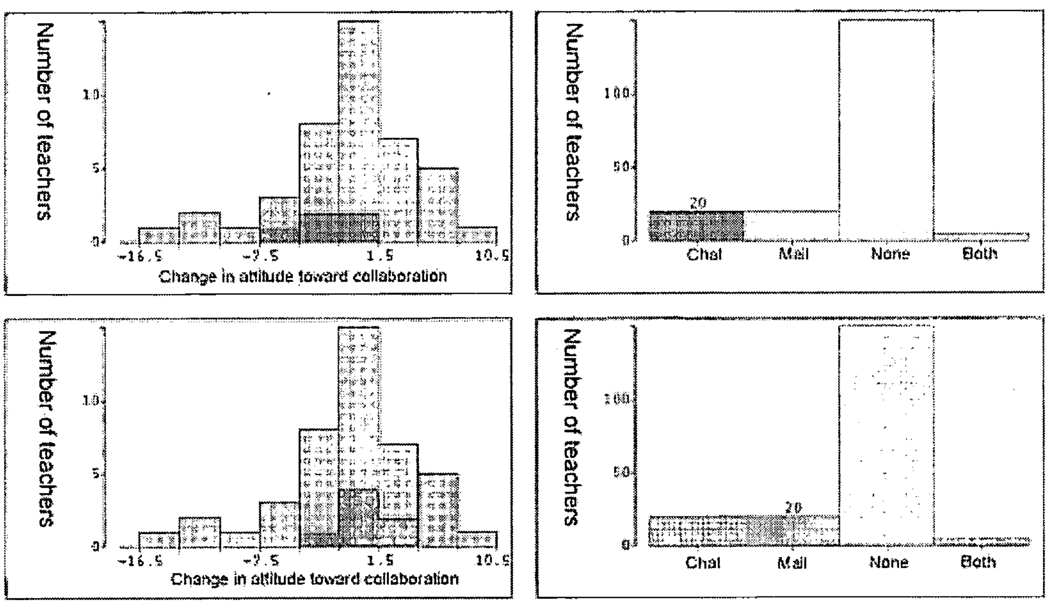

Figure 1: Linked observations between use of collaboration and changed scores in attitude toward collaboration

A Chi-square test of goodness of fit was applied to investigate whether engagement in Internet-based communication could increase the likelihood of completing the entire instructional module (hypothesis b). Likelihood ratio Chi-square was used because it is related to log-linear model and logistic regression model, and completion of module was a dichotomous variable. The Chi-square analysis yielded a significant result, Likelihood ratio $X^2 = 8.19$, p = .042. Because one of the cells had no subjects and some cell sizes were very uneven, a Chi-square test might not be valid. To rectify this shortcoming, an exact test was performed using StatXact (SPSS Inc., 1999). Both asymptotic inference and exact inference yielded significant results. In the former the one-sided p-value was .02 whereas in the latter the one-sided p-value was .03. These results indicate that engaging in Internet-based communication increases the likelihood of completing Internet activities.

As the data structure did not conform to the parametric assumptions of ANOVA, a one-tailed two-sample independent t-test was applied to examine hypothesis (c), regarding whether engagement in Internet-based communication could lead to improvement as measured by the difference between the pretest and the posttest.

Originally, use of Internet-based communication was classified into four groups, namely, use of chat, use of email, both, and none. For conducting a t-test, the first three groups were collapsed into one group. As a result, only two groups remained, namely, use of collaboration and no use of collaboration. The two-sample t-test did not yield a significant result, $t(28) = .61$, $p = .54$. Therefore, use of collaborative tools did not appear to have an impact on test performance.

Regression analysis was adopted to test hypothesis (d), which was concerned with the relationship between attitude toward collaboration and test performance. The assumption of random residual was checked by plotting predicted scores against residuals. The regression analysis disconfirmed use of Internet-based communication as a predictor to Internet skills test performance, R^2 (42) = .0005, $p = .88$. The scatterplot of the two variables did not display a pattern (Figure 2).

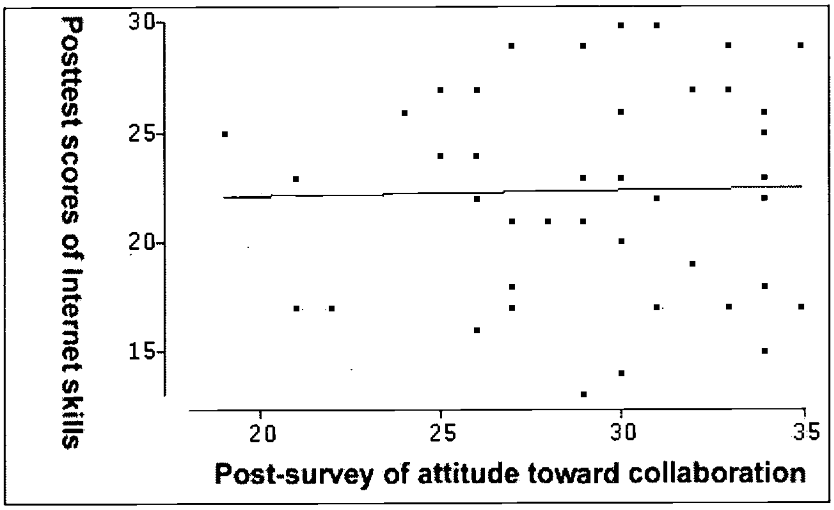

Figure 2: Scatterplot of attitude toward collaboration against posttest scores.

A logistic regression was employed to examine hypothesis (e), which addressed the relationship between activity completion and the attitude toward collaboration in the Internet. The logistic regression analysis did not yield a significant result, $p = .60$, odds ratio = .98, therefore scores on attitude toward collaboration did not predict course completion rate.

DISCUSSION

Collaboration provides a way for educators to form a virtual community of learners in which members can engage in individual thinking, share opinions and beliefs and provide one other with feedback for professional and personal growth and change. In the course studied, Internet-based communication allowed participants to engage in collaboration with others across the state. Although the Internet provides different types of environments for communication and collaboration among users, their effects are as yet unknown. In this study, it was hypothesized that asynchronous and synchronous Internet-based communication provides unique features that promote the development of collaborative communities. In addition, this environment would then impact participants' attitudes toward collaboration and performance on Internet skill tests.

Although in this study it was found that attitudes toward collaboration did not affect test performance, the data suggested a relationship between attitudes toward collaboration and use of Internet-based communication. It is encouraging that use of Internet-based communication increases the likelihood of completing the course activities, though no link by instructional theory was established between the two variables. It was speculated that those who used chat sessions and mailing lists were motivated by their peers, or self-motivated by their own engagement, but no measure of motivation was conducted in this study and thus the issue remains inconclusive.

The results do not substantiate the remaining hypotheses. Therefore it may be concluded that in this population, attitudes toward collaboration are little effected by engagement in an Internet-based course. In addition, using Internet-based communication such as chat sessions and mailing lists do not effect participant performance. Similarly, participants' attitudes toward collaboration do not predict performance on Internet skill tests.

Although not all results lead to positive conclusions, it is important to understand the aspects of Internet-based communication that may contribute to the development of collaboration among educators at a distance. Information about the characteristics of Internet-based communication and methods of implementing effective collaboration must be investigated to increase educators' effectiveness, to enhance achievement for all students and to promote systematic school improvement. This study provides a step toward such research.

Collaboration is not a context-free concept: its implementation is tied to specific types of communication provided by the medium and the specific application within the medium. As indicated in this paper, mailing lists and chat sessions represent two different modes of communication. Within these modes, there is further classification by application such as moderated and unmoderated groups. Findings in this study should not be over-generalized and different research studies for different modes and applications of Internet-based communication are recommended.

Due to the sample size and the distributional assumptions, variables in this study were examined in a pairwise manner. This research project serves as a preliminary study to identify relationships among variables. As relationships are identified, a coherent model specifying the inter-relationships among variables can be constructed. To achieve this goal, structural equation modeling with a large sample size will be employed.

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From Laser Disc to CD-ROM: Adventures at the Low End of High Tech

David L. Byers, Jr.
Educational Services
Carle Foundation Hospital
United States
david.byers@carle.com

Dent M. Rhodes
Department of Curriculum and Instruction
Illinois State University
United States
drhodes@mail.ilstu.edu

Charles J. West
Foster College Of Business Administration
Bradley University
United States
west@bradley.edu

Abstract: This paper describes the process of converting an interactive multimedia training program with laser disc video to a program incorporating MPEG-1 compressed video on CD-ROM. An overview of the hardware and software demonstrates how a conversion can be accomplished by taking a standard, well-equipped personal computer and adding less than $1500 of additional hardware and software. A detailed of process outlines how a quality video production can be obtained with minimal cost. Video capture and edit techniques are outlined to provide a workable template for developers to follow. Working at the "low end" of "high tech" can produce a very acceptable multimedia product.

Introduction

The original interactive multimedia program, *Managing Asthma*, was developed by personnel at Carle Foundation Hospital and Illinois State University. It was used to train staff how to teach asthmatic patients the effective use of inhalers and peak flow meters (Byers and Rhodes, 1998). This program, authored with Asymetrix ToolBook II Instructor 6.0, contained 179 computer screens and a total of 30 minutes of full-motion video edited into 43 separate files. The video was displayed with an overlay board directly on the microcomputer monitor. User control of the laser disc player was enabled through a custom-built program integrated into ToolBook II Instructor.

The multimedia system, i.e., microcomputer, touch-screen monitor, videodisc player and speakers were placed in a self-contained wheeled "traveling case." This traveling case was placed in four departments at Carle Foundation Hospital and at seven of the associated Carle Clinics in Illinois. The system was available in areas such as lunchrooms, break areas on the hospital floor, or staff lounges.

During program development, formative reviews were carried out by health care specialists and designers. These reviews helped ensure that the program incorporated principles basic to the design of successful multimedia training applications (Palmer and Rhodes, 1997). More than 200 health care personnel who used the program completed an evaluation form and selective interviews were also conducted. The response indicated that staff had a very positive experience using the interactive multimedia system and find it quite helpful. More than 70% of those surveyed rated the program as "excellent," and 25% rated it as "good."

Although the program itself had exceptional ratings by users, the logistics of moving the traveling case from location to location and related difficulties of system maintenance became significant problems for health care personnel. While additional programs on asthma management and other disease entities would be welcomed, an alternative to the laser disc format became necessary. Compressed video on CD-ROM would solve many of the problems identified, especially those of portability, system availability and cost. With the proliferation of CD-ROM technology, program distribution would not be limited to the traveling kiosk or only to locations with a similar multimedia workstation. Unlike laser discs, CD-ROMs could be duplicated almost immediately at minimal cost as additional institutional usage dictated. Other features, such as audio over text would be available. A determining factor, however, would be maintaining the quality of video scenes because this was a significant positive factor for users.

Video encoding

As the first step in the conversion process, during the winter of 1998 we examined demonstration versions of some two dozen commercial programs with CD-ROM video. The results were not encouraging, especially for playback on a Pentium 90mhz microcomputer with a 24x CD-ROM player comparable to many of the machines to be found in the heath care setting. The most successful of the program in terms of video quality were those in which the original scenes had been made with "artificial" (blue-screen) backgrounds that reduced the amount of information to be compressed. Since the *Managing Asthma* video had been filmed in a real hospital setting, this was not an option for us.

At one point we considered "leapfrogging" CD-ROM delivery and moving directly to a DVD format. We soon found that an initial startup and certification cost of $50,000, conflicting technical standards, lack of development hardware and software in the university setting and playback units in the healthcare setting made this technology impractical for us, at least for the present.

After considerable further investigation, we located a software program containing compression algorithms that are significantly advanced enough to support required video quality levels on CD-ROM. This program is the XingMPEG Encoder 2.2 from Xing Technologies [www.xingtech.com] at a cost of $249.00. The XingMPEG Encoder will compress 30 minutes of video (.AVI format) into MPG1 files that fit onto one CD-ROM. Screen image resolutions from 160 x120 pixels to 352 x 240 pixels are available.

We have found that both 256 x192 pixel and 352 x 240 pixel images both provide more than adequate video quality for interactive multimedia training purposes. Indeed, by scaling we enlarged the 352 x 240 pixel images to approximately 600 x 400 pixels without noticeable loss of video quality. This conclusion does not come from a controlled research study, but from observation of experienced PC users. We had planned such a formal study, but after receiving user comments such as "That's really great," and "I didn't know you could do that," we simply moved ahead with development. As audio and video are synchronized and there are no obvious computer artifacts with Xing files, video quality is not an issue for viewers.

For the developer, the XingMPEG Encoder has a batch-processing feature that will compress a list of .AVI files without operator attention. The task list feature enables one to reconstruct individual MPG files should changes be required. XingMPEG Encoder supports PAL, NTSC, and FILM formats, with a wide range of data rates from 128kbps to over 1200kbps. Video can thus be customized for various delivery environments such as hard drives, local area networks, or CD-ROMs.

The interface screen for XingMPEG Encoder is very intuitive, displaying the New, Edit, Delete and Encode buttons in the main interface window. For each entry the operator selects the video format desired and identifies the source file and destination file. This feature saves time and minimizes the possibility of errors. The compression process is not time-intensive; for example, we found that a 30 second .AVI file could be compressed into a .mpg file in about four minutes. Batch processing can be set up to run overnight without operator intervention. In this conversion project, 30 minutes of video in 43 .AVI files spanning 4.2GB of uncompressed data were compressed to an equal number of .mpg files spanning 481MB resulting in a compression ratio of 8.79 to 1. As a compact disc will hold 650MB of data, adequate storage for program, graphics, and audio files was still available.

Video capture and editing

Without quality digital .AVI files captured from analog video, compression to MPG1 is not a profitable venture. We have found that the Miro DC30 Plus capture card and associated software from Pinnacle Systems [www.pinnaclesys.com] at a cost of $900 has done everything that we require. The Miro DC30 card will capture NTSC (composite and S-Video) and PAL analog video at 7MBps with minimal frame loss, perhaps one frame for video minute on the PC employed. The software for Windows 95 comes bundled with the board; the user interface is simple and procedural. Software for Windows NT can be downloaded from Miro; the user interface is more sophisticated, with both introductory and advanced levels. We have used the Miro D30 card and software to successfully capture motion and still frame video from S-Video, Hi8, and VHS tape decks and, for the *Managing Asthma* program specifically, a Pioneer laser disc player.

The capture process was made much simpler by having the file names and entry and exit points on the laser disc defined before capture. All systems used the "capture to memory" feature with the overflow going to a hard disk. When capturing video from laser disc or S-Video tape, a thin bar of unsynchronized video appeared across the bottom of the capture window. This problem was resolved by selecting the "TV cropping" setting. We captured NTSC video, quarter screen, with square pixels at a rate of 29.97 frames per second. Once the process was mastered, which took less than a day, fewer than three minutes were required to setup each video sequence for capture.

Because the video scenes had already been prepared for the laser disc version of *Managing Asthma*, video editing was only a minor part of the conversion process. When capturing video, we began about a second before and ended a second after the designated segment. The excess frames were easily cropped during editing. We experimented with cropping files using two editing programs, Adobe Premier 4.2 and MGI VideoWave. Both were satisfactory for our purposes, though with differences: Premier has more editing features than Video Wave, but with its relatively complicated interface is more difficult to use.

PC hardware and software

The personal computer used in the conversion process was a Dell 300MHz Pentium II machine with 10GB of EIDE storage and 128MB of memory. SCSI hard drives would have been preferable to the EIDE drives in efforts to minimize frame loss during video capture, but the latter were adequate for performance in this project. The hard disk space required for video capture depends directly upon the amount of video to be captured. The .AVI files required approximately 1MB per second of video captured. Digital .AVI files are about 10 times the size of compressed .mpg files, and space for both is needed during the compression process. In the configuration we used in the capture process, the resulting .AVI files were uncompressed.

We were able to store the 43 video files of *Managing Asthma* in both formats with space to spare. A Gateway 200MHz Pentium Pro processor in another machine also proved to be satisfactory for video capture and compression, but a Gateway 100MHz Pentium did not. There was a significant loss of frames in the capture process when a Gateway 100MHz PC with 64MB of memory was used.

The compact disc recorder (CD-R) in the PC was the latest Sony model with bundled Adaptec Direct CD software. We upgraded the software to Adaptec Easy-CD Pro 95. There were a number of problems with this hardware/software combination. We could, with enough time and effort, make an acceptable CD-ROM containing video and ToolBook II Instructor program files, but eventually removed the Sony from our development system. We settled on a Hewlett-Packard 4020i CD-R and Adaptec Easy Creator Deluxe [$100]. Easy CD Creator Deluxe has more features than Easy-CD Pro 95, including CD duplication, and is very reliable.

Production

The procedures for capturing, compressing, and editing the video scenes were relatively straight-forward, and the learning curve associated with hardware and software described above was not particularly steep. Adventures at the low end of high tech began in earnest when the various components of the development system were combined to produce the new CD-ROM version of *Managing Asthma*.

ToolBook II Instructor was retained for authoring, since we believed that using it would minimize conversion cost and conversion time. As program designers, we had worked with versions of ToolBook since Release 1.53 and were familiar with its idiosyncrasies, or so we thought. Even after an upgrade from version

6.0 to version 6.1a, there was a steep learning curve for incorporating digital video in an MPEG format into *Managing Asthma*. It was necessary to make significant modifications in the original ToolBook II Instructor program to use CD-ROM rather than laser disc video.

In order to control playback of the video segments, the ActiveMovie Control Object extensions, a feature of Window 95, must be added to the ToolBook II Instructor environment. These extensions enable the developer to use drag and drop technology to insert, position and size the window in which the video is to be played. The next step is to set the ActiveMovie properties. Displaying the default video controls (play, pause, stop rewind and fast forward) can be enabled or disabled as desired. We developed a simplified set of customized controls for video control. Nearly 50 parameters, such as size, window placement, auto-play and auto-rewind, are configurable.

In ToolBook II Instructor, the properties can also be set using scripts. The ToolBook II Instructor search and replace feature makes this method easier to use when making a comprehensive change in parameters such as the video display window size. For example, the sample script displayed below sets the display area, file to be played, disables auto rewind, plays the video segment and stops at the end of the segment with the last video frame displayed.

```
set bounds of ActiveMovie "Video" to 2000,700,8000,5000
set extMovieWindowSize of ActiveMovie "Video" of page "videoIntro" to 3
set extFileName of ActiveMovie "Video" of page "videoIntro" to / vDrive&":\asthmaMpg\astintro.mpg"
set extAutoRewind of ActiveMovie "Video" of page "videoIntro" to false
get extRun() of ActiveMovie "Video"
```

While the process is not difficult to describe, it did not operate very smoothly in practice. Asymetrix does not have "native support" for playing .MPG video files; that is, ActiveMovie is an "add-in," not part of the ToolBook II Instructor environment. ActiveMovie is not documented or supported by Asymetrix and minimally documented by Microsoft. ActiveMovie properties such as screen size and video file name that were configured with object control extensions would not remain stable in ToolBook II Instructor. We found it beneficial to save the file after every change. The "drag and drop" function to set the screen size was not operational; changes were made by adjusting parameters in the ToolBook II Instructor script. Some ActiveMovie parameters were operational in the script; others did not seem to be.

Naming conventions for .AVI and .MPG files were limited to the 8.3 standard because of ActiveMovie and ToolBook II Instructor constraints; file names were also case-sensitive. Thorough documentation, formerly often an afterthought, became a necessity. Every programming session was indeed an adventure. Eventually we were able to determine the optimal, if not ideal, relationship between setting parameters through ActiveMovie object control and ToolBook II Instructor scripting.

Packaging

Once the program was converted we needed to package the application in a way that the end user could easily install the software. The AutoPackager utilities supplied by Asymetrix provide the ability to distribute a professional looking installation program for a ToolBook II Instructor application. This program gives the developer the option to select the target distribution media of CD-ROM, floppy disk or Internet and set default configuration selections for the installation of the program. One of the more useful options is the ability to have the installation process copy the assortment of ToolBook files to the hard disk and allow the large video files to remain on the CD-ROM. Unfortunately this option does not support add-ins such as the ActiveMovie extensions we used. Video files thus had to be added to the distribution disc separately. We did use the packaging option for storing the audio overlays used in *Managing Asthma*.

Further development

We have decided to reduce the amount of adventure in further development by shifting to Visual Basic as an alternative to ToolBook II Instructor, even though we have been very pleased with what we have been able to do with ToolBook over the years. Visual Basic will provide a more stable environment for programming in general and ActiveMovie specifically. ToolBook II Instructor does not have support in the settings in which we work; Visual Basic is fully supported. Furthermore, extensive online support, user groups and many third party add-in modules are available for Visual Basic. Special promotions for Visual Basic are often to be found in academic settings; these promotions may lower the cost by as much as 75% from advertised prices.

The CD-ROM version of the program will receive the same type of use in "real world" settings as did the laser disc version. We will be determining whether the projected savings of logistical and maintenance time and money can be realized. Of most importance will be the response of health care personnel to this new delivery system.

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Mining the Past for Hints of the Future: Should Educators Trust the Promise of Universal Service?

Sousan Arafeh
Department of Communication Arts
&
Department of Curriculum and Instruction
University of Wisconsin – Madison
United States
smarafeh@students.wisc.edu

Abstract: Struggles over educational access to new communications technologies in the age of US radio and television provide insights into current struggles of educational access to the "information superhighway". Findings from an historical analysis of these earlier periods show that educational access to new communications technologies is often constrained or marginalized in 4 primary ways: 1) definitional distinctions in law and policy, 2) high costs and technical operating standards, 3) technical ghettoization in low-power, low-reach technologies, and 4) mid-stream legal and policy modifications including challenges to regulatory jurisdiction. Similar methods of constraint are identified in the current context of universal service e-rate discounts for K-12 access to the NII. It is suggested that educators should be excited about NII service discounts, but wary of regulatory constraints.

Introduction[1]

The information age is upon us and the Clinton Administration's 1993 policy mandate to connect all schools to the National Information Infrastructure (NII) by the year 2000 has placed the education community at center (Information Infrastructure Task Force 1993). Such connections are not only necessary for educational delivery and achievement, it is claimed, but also for building a publicly accessible advanced telecommunications network for the nation. The *Telecommunications Act of 1996* is the legislation recently enacted to usher in the promise of this new age. Its universal service "e- rate" provisions establish discounts and encourage public/private partnerships so that K-12 schools, public libraries, and rural health care systems across the nation can defray the costs of accessing advanced telecommunications services.

But should educators trust the promise of the universal service e-rate as a way to ensure their access to the NII? There can be no doubt that the NII's advanced telecommunications networks and information systems have much to offer our educational, local, national, and international communities. Likewise there is precedent in US communications history for tempering market forces by regulating for the public interest. If we consider the history of how radio and television were introduced and regulated for educational access and use, can we find insight into the current situation?

In this paper, I report findings from an historical analysis of struggles between 1912 and March 1999 over terms and efforts to regulatorily ensure educational access to radio, television, and networked computer technologies. By submitting policy documents and related academic and popular articles to methods of textual analysis and genealogical discourse analysis (Foucault, 1984), I found that education is consistently constrained from being afforded secure and autonomous access when new communications technologies are introduced. Although access is supported rhetorically, financially, and regulatorily –both by government and the private sector – it is limited regulatorily through 1) definitional distinctions in law and policy, 2) high costs and

[1] For the sake of space, I have not included references to legislation or regulatory decisions that can be found using the title and date references provided in the text.

technical operating standards, 3) technical marginalization in low-power, low-reach technologies, and 4) mid-stream legal and policy modifications including challenges to regulatory authority of the FCC.

I argue we are currently seeing these kinds of constraints in the case of universal service e-rate provisions. Thus, my analysis would seem to suggest that the education community should both embrace and be cautious about the promise of the NII. For while advanced communications networks offer possible solutions for problems relating to providing K-12 education to a highly diverse national population, as in the past, they also threaten to either impose significant economic and organizational hardship on schools and their communities, or saddle them with unusable or marginal technological capabilities and unfulfilled hopes.

Limiting Educational Access to Communications: The Case of Radio

New technologies create the need for new regulations. When radio was introduced, for example, US legislators felt it necessary to regulate it so that dedicated frequencies could be set-aside for defense uses. In the US's first communications regulation -- the *Communications Act of 1912* -- a system of licensure was established that allocated particular spectrum frequencies to particular licensees. These early laws and regulations were constitutive in education's marginalization in communications.

In the first place, the 1912 *Act*, defined licensees as "persons, companies, corporations", and successive amendments defined them as "individuals, firms, or corporations" (1927), and as "persons, corporations, and amateur stations" (1934). Nowhere did the language of these early laws deem public educational institutions viable licensees, unless tied to private or government research under the 1912 provision for "conducting experiments for the development of the science of radio communication".

Secondly, The 1927 *Communications Act* established costly licensing fees and required that stations operate with stronger signals, longer hours, facilities built to code, etc. In 1929, *General Order 40* re-allocated spectrum and placed educational stations in low-power, low-reach frequencies which, although they were more expensive to operate, were more difficult to receive. These legislative and technical decisions had a chilling effect on educational uses of new radio technologies. Without the deep pockets or the technical acumen of their commercial counterparts, educators were often unable to meet the new, significantly more taxing financial and technical commitments of the late 1920s. And, because their stations were low-power and low-reach, they had trouble developing markets. By the time the *Communications Act of 1934* was passed, reports like the following were not uncommon:

> Professor Jerome Davis of the Yale University Divinity School presented...the results achieved by the present radio law. When it went into effect there were ninety-four educational institutions engaged in broadcasting; today difficulties put in their way are so great that many, including Columbia University and the Massachusetts State Department of Education, have given up entirely, while many of the others are rendered almost useless by the policies of the government (The Nation 1934, p. 201).

Despite these developments, there was some financial and institutional support for educational broadcasting. For example, the Office of Education for established a Radio Section in 1929 to "initiate and assist with research studies of radio" for adult education (Saettler 1990, p.213). The Payne Fund continued its long-standing support of lobbying efforts to set-aside dedicated non-commercial channels by coalitions like the National Committee on Educational Radio (NCER) (McChesney 1993). President Roosevelt allocated $75,000 to the Office of Education in 1935 to develop educational programming (Arafeh 1998). And, radio corporations offered free air time for educational broadcasting as part of their "public interest" mandate (Studebaker 1936)[2].

While each of these efforts generously contributed to the cause of educational radio in their different ways, commercial stations had a particularly strong effect. Not only were their lobbies strong, their willingness to broadcast educational programming for free made it difficult to justify the more costly alternative of educators owning, making, and running their own stations and shows.

By 1936, then, the question was more one of how education could contribute to commercial broadcasting's "public interest" mandate than how it could gain dedicated station access and programming control. This quote by Commissioner Studebaker from the 1936 National Conference on Educational Broadcasting is instructive,

[2] US Commissioner of Education J.W. Studebaker (1936), noted that "the commercial sale value of the [radio] time used by the Office of Education during the last six months has been estimated at several hundred thousand dollars. That is an impressive amount of money...And yet these [private radio] companies provide free time on the air to the Office of Education and to other educational and non-commercial organizations" (p.3).

particularly in light of current efforts at public/private partnerships for advancing the NII:

> Suppose we state the problem this way: How can public enterprise use a utility which is privately controlled? Let me repeat that: How can public institutions (educational organizations) use the publicly owned airwaves which are controlled by private enterprises under federal licenses? Is this the basic question that confronts us?...[T]o gain our objectives, educational broadcasting requires that we pool our knowledge of educational purposes and of planned instruction with the practical experience of broadcasters schooled in the technical complexities of radio...Let us – educators and broadcasters – go forward together (Studebaker 1936, pp. 4-5).

Educators and broadcasters did go forward – often together – but push-me/pull-you frequency set-asides and spectrum re-allocations kept educators off balance. The 25 AM channels reserved by the FCC for in-school educational use were later transferred to FM spectrum where limitations in bandwidth left only 5 low-power channels intact (Sterling and Kitross 1990). By the end of 1941, there were only 2 FM education-run stations which grew in 1945 to 6, and then to 90 in 1952. Frequency relocation to the 88-108MHz bandwidth, and changes in FCC guidelines that allowed education-run stations to broadcast with only 10 watts of power (5-10 mile reach) contributed to this upswing in educational radio stations. While the positive impact of these regulatory technical changes can be seen by the dramatic increase in stations between 1941 and 1952, educational aspirations were likewise limited by low-power stations and regulatory uncertainty. This is the fourth method of educational constraint to which I want to draw attention: 4) mid-stream modifications and revisions in policy, legislation, or administration that either frustrate or erode legitimate access and positive activity.

These four specific regulatory techniques helped marginalize the education community's radio use, often resulting in reliance on, and collaboration with, commercial enterprise. Federal and state governments were pleased with such arrangements because it relieved them of funding and staffing a more robust educational radio sector. As well, the primary burden of communications infrastructure development was placed on private industry which benefited because it was assured control of the medium and income from government- and foundation-subsidized educational programming. The education community, however, was placed in a role of dependence. As the promise of television loomed on the horizon, little would change.

Limiting Educational Access to Communications: The Case of Educational Television

The mid-40s increase in educational radio channels was partly due to regulatory and technical modifications required by the advent of television in which education got a poor start. The War Production Board imposed a station construction freeze between 1942 and 1945, and the FCC a debilitating license freeze in 1948 that lasted 6 years. Education was unable to get its foot in the television door during these early boom years.

During 1950 and 1951 of this of this hiatus, the FCC held hearings to determine the new regulatory scheme for both radio and television channel assignments, as well as for color television standards and educational television set-asides (Saettler 1968). A combination of lobbying efforts by the Joint Council on Educational Television (JCET), research provided by the National Association of Educational Broadcasters (NAEB), and the active participation of FCC Commissioner Frieda Hennock did result in 242 channels (most in the UHF band) being set-aside in 1952 for the education community. Educational broadcasters were encouraged by this show of FCC support as well as the generous sponsorship for program development provided by the Ford Foundation's *Fund for the Advancement of Education* (TFAE) (Brinson 1998, DeVaney 1990, Saettler 1990).

As in the case of radio, however, channels were located in low-power UHF frequencies that were more expensive to operate and could not be picked up by all television receivers. Four years after UHF ETV channel WOSU broadcasting in Columbus Ohio, for example, 85% of the sets in its market were still unable to receive its signal (Baughman 1985). This devastated educational broadcasters who, now subject to more stringent ratings measurement schemes, were hard-pressed to justify station ownership and operation for such small markets. Even with the success of the 1952 channel reservations then, educational broadcasters once again faced structural barriers and technical marginalization that hindered their ability to provide consistent, wide-reaching, and receivable educational programming to the schools and communities in their particular areas.

Educators' struggles for more favorable circumstances took a distinctly different turn in 1962 when Congress passed the *ETV Facilities Act*. Partly a response to an increasingly uncontrollable commercial sector, and partly an attempt to bolster the goals of Johnson's Great Society program, this Act initiated federal funding and regulatory support for *public* broadcasting[3]. As a result of the Act, ETV channels increased from 52 in 1961 to 114 in 1966 and then to 252 in 1972 (Sterling and Kitross 1990) – still in the low-power frequencies.

Between 1962 and 1967, educators sought programming from the Ford Foundation's National Educational Television Center (NET)[4] and settled in to one of the most robust, autonomous educational broadcasting moments in US history. Stations were in place, funding was available, and programming was on the rise. When the Johnson Administration's appointed Carnegie Commission's recommendations on extending the *ETV Facilities Act* were enacted in the *Public Broadcasting Act* in 1967, however, such halcyon days were over.

This Act not only passed control and funding of educational broadcasting to a publicly-funded but semi-private Corporation for Public Broadcasting (CPB), it also definitionally changed the educational broadcasting charge from one of either "educational" or "instructional" programming (i.e. ETV or ITV) to one of "public" programming. Within this definitional shift, ETV's instructional mission – which included distance initiatives up to this point – were excluded from public broadcasting's mission. "Public" broadcasting intoned broadly "cultural" programming. Once again, definitional requirements resulted in a marginalization that not only barred educators from being able to pursue what they had perceived to be their primary program content domain but, this time, also resulted in a loss of their stations to a semi-private government agency. This left the lower-power, lower-reach stations – particularly the closed-circuit, microwave-distributed Instructional Television Fixed Service (ITFS) systems –for instructional use. In the best cases, municipalities and states have developed local and regional instructional networks from these facilities. However and again, here was another case where education was being definitionally and technically marginalized while simultaneously being kept off-balance by uncertainty in policy and legislative determinations.

Cable broadband technology produced a similar scenario. Early days of its regulation held educational promise as the FCC encouraged cable systems to provide "public access" (i.e. channels designated for autonomous public, educational, and government use) through an informal recommendation in 1969. In 1972, the FCC mandated that cable systems serving areas with 3500 or more subscribers provide PEG channels and educators found yet another opportunity to utilize new communications infrastructure for their curricular and pedagogical purposes (Engelman, 1990).

Unfortunately, the Supreme Court ruled that the FCC was not authorized to mandate PEG access in *FCC v. Midwest Video Corporation* in 1979. This, in combination with the *Cable Communications Policy Act of 1984's* statutory location of jurisdiction for negotiating PEG set-asides in municipalities, had two effects. First, it reduced the likelihood of establishing PEG channels and, second, it continued the trend of technical marginalization by virtue of PEG stations being available only to cable subscribers within a small geographically-bound system (Arafeh 1992). What the case of cable shows, however, is one more form of mid-stream modification to laws and regulation: annulment of regulatory determinations through formal challenges to the jurisdiction and authority of the regulating body – the FCC.

To date, schools and districts have had varying degrees of success using television for education. This is partly because they have had trouble gaining access to production equipment and facilities, partly because regulations continue to change, and partly because they do not have the financial and human resources. Some states and regions have been able to develop quite robust educational networks (i.e. Iowa, South Carolina, etc.). This outcome has been facilitated in more recent days by regulatory initiatives like the StarSchools program. It is safe to say, however, that educational broadcasting has, and continues to be, difficult for schools to undertake – especially elementary and secondary institutions.

Conclusion: Lessons from the Past and the Promise of Universal Service

Combining the informational and computational power of computers with the fast and wide-ranging distributive power of telecommunications networks presents an unprecedented opportunity for commercial, interpersonal, and educational interaction. Or does it? Do these limited insights on the past help provide perspective on the present and future?

It would seem so, for while networked communications hold possibility for education, so did radio and

[3] The Act also mandated that all television sets be manufactured with UHF and VHF reception capability.

[4] Originally the National Educational Television and Radio Center, which was founded in Ann Arbor, Michigan in 1954. A collective that developed educational programming, it changed its name in 1963 to the National Educational Television Center (NET) and received funding from the Ford Foundation (Sterling and Kitross 1990).

television. Once again, K-12 access to new communications technologies is controversial; and the four regulatory constraints that I have outlined above remain hard at work.

The universal service e-rate program has been very successful in some respects. Over $1.4 billion dollars in discounts have been allocated to 94% of the schools that applied, and 54% and 48% increase respectively in schools and classrooms from 1994 to 1998 has been reported. At this rate, connecting all K-12 schools to the NII by the year 2000 may be an attainable goal, that already seems to be decreasing the positive correlation of school connection to the NII with race (Digital Beat, 1999).

The e-rate program is also being contested, however. The *Telecommunications Act of 1996* has deemed K-12 schools as having no legitimate interest in networked telecommunications other than as service end-users needing service discounts through an e-rate – a definitional distinction that supports the historical information provided above. And, as in previous communications scenarios, schools may be marginalized, or even ghettoized, by their less-than-state-of-the-art technology and, ostensibly, increasingly low-technology connections. Already there are password- and technically-driven "levels" to the Internet which distinguish commercial and government users from public and public institutional users like k-12 schools. Legislation like the *Next Generation Internet Research Act of 1998* and the *Technology Administration Act of 1998* are already trying to establish the I-NET, a value-added Internet, which again threatens to create and justify new technologies and capabilities outside of K-12 education's reach. Not every NII application is appropriate for elementary and secondary schools. Yet, as our conceptions of what these technologies can and should do are formed in early research, development, and implementation phases; educational and public aspirations should not necessarily take a back seat. As my research shows, limits to sophisticated technology has been particularly damaging for explorations of innovative ways education can contribute to uses of new communications and, in doing so, contribute to the public and national interest.

Lastly, there have been sufficient mid-stream modifications to e-rate legislation and its administration to keep educators off-balance and unable to plan for their futures. Telecommunications service providers have filed suits claiming that the financial obligation is overly burdensome and that cost models are unreasonable (c.f. ALAWON 1999b). Industry has also chosen to "pass through" their universal service costs to customers', creating public stir and political anxiety (Atlanta Journal and Constitution 1998). Some federal legislators have challenged the FCC's authority to create a non-profit, quasi-public Schools and Libraries Corporation (SLC) to administer the funds (Simons 1998), as well as the FCC's authority to pursue social policy goals through its regulatory activities (Broadcasting and Cable 1999). These regulatory destabilizations have created a stunting period of uncertainty, chaos and, at times, paralysis as administrative jurisdiction continues to change and the FCC walks on egg-shells in order to keep legislators from dismantling it. Most recently, there has been proposed legislation to require that schools receiving e-rate discounts use filtering software[5], and that the e-rate program be "killed" altogether [6]. Such opposition to supporting educational access to networked communications will inevitably have devastating effects.

Should educators trust the promise of universal service? This history suggests that they probably should not. And this is bearing out as the universal service e-rate program – and the schools, students, and communities it is supposed to benefit – is close to drowning through regulatory measures once again. There is the potential that this will be just another unhappy chapter in education's long history of attempting to benefit from, and positively use, communications technologies in the course of its work of educating the nation's children. However, it is my hope that the insights regarding K-12 education's marginalization relative to new communications technologies provided in this paper urges education advocates to keep their eyes on high-level policy, legislative, and regulatory activity – particularly when new technologies emerge. Only in this way will the educational community – and the public-at-large – gain assured, robust access to new communications technologies now, and in the future.

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[5] See Senator McCain (R-AZ) and Representative Frank's (R-NJ) various versions of a *Children's Internet Protection Act* (S97IH, HR896IH, and HR543IH), and Representatives Shows (D-MS) and Oxley's (R-OH) *Safe Schools Internet Act* (HR368 IH).

[6] See Representative Tancredo's *E-Rate Termination Act* (HR368IH).

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The Development of a Multimedia Instructional CD-ROM/Web Page for Engineering Graphics

Stephen W. Crown
Department of Engineering
University of Texas – Pan American,
United States of America
scrown@panam.edu

Abstract: The positive response to a tutorial video tape developed for an engineering graphics class ultimately lead to the development of a comprehensive multimedia instructional CD-ROM/web page. The project in its current state consists of an integrated web site with links to hours of tutorial movies, lecture presentations of all class lectures, web-based games that reinforce significant course topics, and a series of interactive web-based quizzes. The through discussion of the specific methods and tools used to develop each component of the project is presented including a discussion of the many challenges encountered. A realistic picture is painted of how the project both positively and negatively has impacted the course and individual students. A detailed estimation of the overall time investment made in the development of the project provides a reference for those considering undertaking a similar project. The overall outcome of the project was positive and has led to an expansion of the project to include the offering of an on-line graphics course and the development of similar work for other engineering courses.

Background

Engineering Graphics is an introductory engineering course that teaches the fundamentals of graphical communication and how to use a specific computer aided design drafting (CADD) software package. The course is often the first engineering course that students take and many base their decision about their future as an engineering student on their experience in this course. A number of area high school students also take the graphics course each semester. A positive experience in this course commits students to the engineering program and motivates them toward completion of their degree.

Running counter to the objective of providing a positive experience in the engineering graphics course are several realities faced by all academic institutions. Economics dictate high student to teacher ratios even in a laboratory setting. Laboratory assistants do not have the same level of training or motivation as the professor. Students enter each course with varying backgrounds, learning abilities, and learning styles. Such realities often lead to a course that caters to the average student leaving slower students confused and brighter students bored.

In an attempt to provide a positive experience in engineering graphics for all students while addressing the issue of individual student needs a video taped tutorial session was developed. The tutorial was a compilation of staged individual tutorial sessions that addressed the most common problems which students encountered while completing the homework. The feedback from the experiment was very positive and required only a few hours of staged tutoring. One criticism of the video tutoring, however, was the separation of the tutoring and application. To address this student concern a screen capture program was used to record screen activity and audio for the staged tutorial sessions. The reception of these tutorials which could be viewed in the computer lab and run simultaneously with the CADD software was extremely positive. Encouraged by the results, the tutorial movies became the first step in the development of a comprehensive multimedia instructional CD/web page. The project to date includes hours of tutorial movies, lecture presentations of all class lectures for the semester, web based games to reinforce significant course topics, and a series of interactive web based quizzes that prepare students for class exams. Similar multimedia teaching projects have been developed for other courses and disciplines such as engineering (Haugsjaa & Woolf, 1996, Hill et al., 1998, Reed & Afjeh, 1998, Suni & Ross, 1997), mathematics (Antchev et al., 1996), and computer science (Marxhal & Hurley, 1996). The engineering graphics project has been successful to the point where students rarely seek individual tutoring during lab and almost never need help outside of lab. The CD/web page accommodates the different learning styles and abilities of students in the class by providing a wide range of instructional material (Carver et al., 1996, Ellis, 1996). What was only partially accomplished in the lab with the constant presence of an instructor and lab assistant is now accomplished with the CD and very limited lab assistance. The final stage of development will be to include a multimedia presentation of the lectures in the project. The entire course, lab and lecture, could then be offered as on on-line self-paced course with hours of interactive tutorial and review material that would give students a positive experience in engineering.

Methods and Tools

The selection of tools used in the development of the CD was initially based on the availability of and familiarity with particular software titles. As the project developed and certain obstacles were encountered a greater breadth of software was considered. The information contained on the CD project is accessed through a series of linked HTML pages highlighted with animated GIFS created in AutoCAD and AVI clips obtained with a video capture card. The lecture presentations are accessed through links to Microsoft PowerPoint presentations (Figure 1). The laboratory tutorial material is presented using Lotus Screen Cam movies. The games and quizzes are HTML files that use simple Java Script 1.2 code. The information was created and compiled on a 200mHz Pentium and then burned onto recordable CDs and uploaded to a public directory on a Unix based server. The entire project requires slightly more than 300MB, the Screen Cam movies taking the bulk of the disk space. The development of each element of the project was affected by the capabilities of the selected hardware and software. A prior understanding of the limitations and capabilities of hardware and software would have averted many of the obstacles encountered.

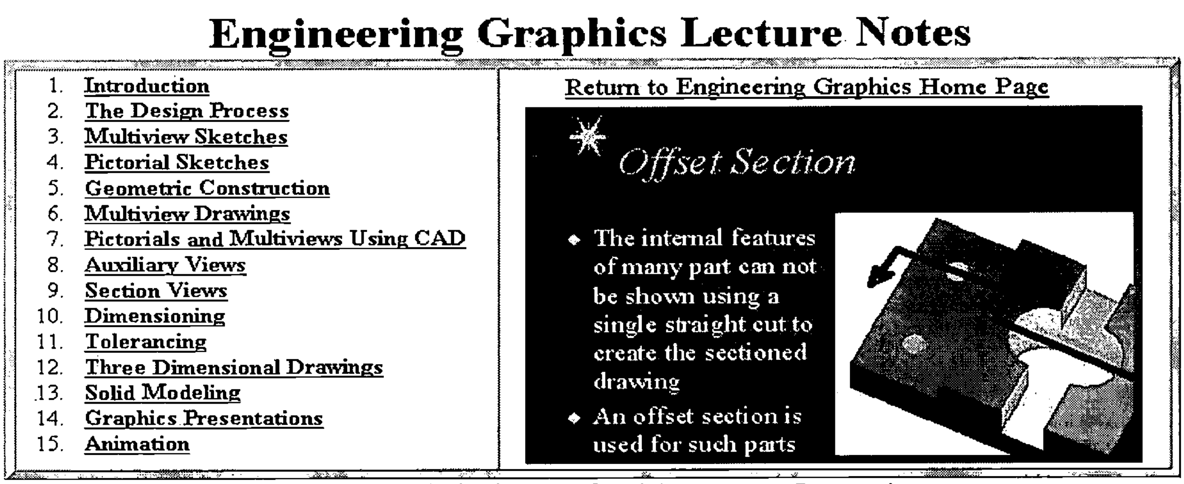

Figure 1: Web Navigation Page for Links to Lecture Presentations

Lecture presentations

The original lecture presentations were prepared using PowerPoint. The lecture material presented on the CD is simply a copy of the lecture presentations used in class. The essential capabilities of the presentation software for this project are: the ability to efficiently embed large high quality line drawings and images into slides; the availability of a free viewer for viewing the presentation; and simple but significant navigation capabilities in the viewer. Some limitations in the software that were encountered were the inability to embed animated GIFS or MPEG clips into the presentation and the absence of a web browser plug-in for earlier versions of browsers. These limitations with the exception of animated GIFS have been addressed with the latest versions of software.

The presentation software allows for the creation of HTML pages with control buttons and an index of all slides in the presentation. However, the HTML pages scale down the image size to a selected fixed resolution and use a significant portion of the screen for slide control. In addition, the HTML pages also do not allow for animation of slides. Because of these limitations the lectures were saved in the original presentation format and with links to the files from the web page. This requires that the browser is set up to launch the presentation viewer program based on the MIME type if the file is on a server or based on the file extension if the file is on the CD. An HTML page showing how to setup the computer and the web browser was added to the web site to address this issue.

Tutorial Movies

The tutorial movies were created with Lotus Smart Suite is Lotus Screen Cam. The program allows for real time screen capture synchronized with audio. This type of screen capture program allows for the simple creation of tutorial movies. The format used for the Engineering Graphics course was for the instructor to do each homework assignment using the CAD program while the screen capture program records the session. The accompanying audio could be recorded with the video or added later. The finished product is then a set of narrated tutorial movies that walk the student through each assignment.

The usefulness of the tutorial movies lies in the fact that they run on the same platform as the program that is being taught. The movie can be paused while the student completes a portion of the assignment and then continued. In this fashion students having difficulty with the homework will follow the tutorial step by step while more advanced students will watch the entire movie and then complete the assignment on their own. The movies can be broken into major segments that allow the user to jump forward or back to the start of each segment. The player also allows the user to fast forward through each segment. The movies require about 400-700kB/min (typically 60-70% for the audio) of storage for a 600X800 screen with 24 bit color and 8 bit mono sound sampled at 11kHz and compressed with a 2:1 compression ratio. The size of a typical 10-minute tutorial would be about 4mB.

There are several notable limitations to the software which affect the use and creation of the tutorial movies. The greatest challenge to creating the tutorial movies is to create a long movie that does not contain pauses or errors since the screen capture program does not allow for editing of movies. If a long pause or error is made during the recording the movie must be redone. Completing a ten-minute engineering drawing without pauses or errors requires planning and several attempts. One way to address this is to record the tutorial in segments saving each as a separate movie. The segments can then be compiled into a single tutorial movie. Therefore, if an error is made in the last segment, only the last portion needs to be re-recorded. The screen capture program is also sensitive to the video drivers used. When using the CAD program a portion of the cursor often disappears and occasionally the program would occasionally not refresh the video when objects were added or erased. The use of some drawing and editing commands had to be avoided to address this problem which was restrictive.

There are a two drawbacks with the program related to playback. First, the image size is fixed at the time of recording so a low level of resolution must be used to accommodate a variety of users. Second, the player does not allow the user to rewind the video except to the start of each segment. This can be frustrating to students and is their primary complaint about the tutorials.

Java Script Games and Quizzes

A game and quiz were written to supplement the material covered in each lecture and associated lab. The quizzes use forms with radio buttons to record answers to True/False and multiple choice questions. The answers are stored in an array and compared to the array containing the correct answers when the user selects the grade button. The number of questions missed are displayed using an alert window. The students can then change answers until they receive a perfect score. The quizzes give instant feedback to the student, are interactive, and are very simple to create. Once the format for the quiz page is set up it only takes a few minutes to adapt questions for another chapter. The JavaScript quizzes have given the best return given the limited investment of time.

The games give students exposure to images and animations that were created in the CAD program that they are learning to use. The games were all developed using JavaScript code to manipulate graphic images based on user input. .The simple manipulation of images based on user input allowed for the development of a wide variety of games which each effectively teach some element of engineering graphics. The first and simplest game gives an palette of images that must be placed on a grid in the proper order (as in a puzzle) to reveal a computer generated model of a utility van generated in CAD. On completion of the puzzle an animated GIF is displayed which shows the vehicle in motion and a simulated impact with an automobile. Another game allows the user to manipulate a 3-D object such that it will fit correctly into a hole. Two other games use image maps (Figure 2) to record input from the user while the graphics change according to their response. With the development of 5 different game formats a variety of other teaching games could easily be developed using the same formats.

The games were the most challenging and problematic endeavor on the project. The JavaScript is not as straight forward as the quizzes and requires more programming skill. More difficulties were also encountered with how different browsers and versions of browsers handled the placement of graphics images. The games do not work with Microsoft Internet Explorer 3.0 and earlier versions or with early versions of Netscape. The selection and placement of images with the mouse causes problems if the user tries to drag the image into place or moves the mouse while pressing the select button. Feedback from some students that the games don't work reveals that instructions to games would be helpful. The level of success achieved for someone with little programming experience and no JavaScript experience however was surprising. It can be assumed that an experienced programmer could address many of the obstacles encountered.

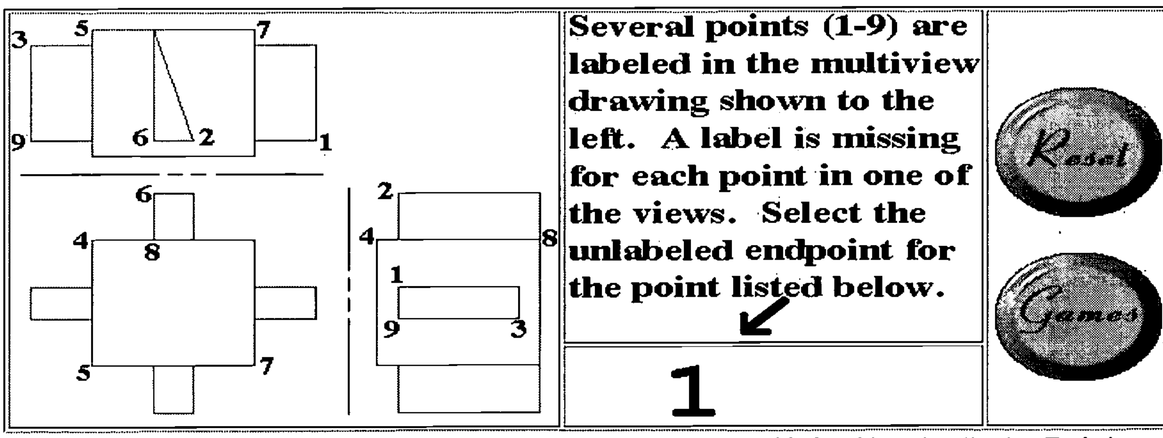

Figure 2: A JavaScript Game That Uses an Image Map to Aid Students With Graphics Visualization Techniques

How the Project Has Impacted the Course

The development of the CD has impacted the course in several significant ways. In the past engineering graphics was taught by a number of faculty and the lectures were presented in the lab to relatively small class sections. As the engineering program grew it became necessary to combine the lab sections for lecture and rely on teaching assistants for the lab. The positive impact of these changes relate primarily to the instructor. By combining sections the total lecture time has been reduced by 80%. The use of the CD in the lab has in many ways eliminated the need for the instructor in the lab. On the negative side large lectures (70-80 students) are less interactive and more impersonal. The laboratory environment has also become less interactive and more impersonal with the exception of student interaction with the computer. There is no longer a need for group teaching in the lab as each student is individually tutored on the computer. Since the tutoring uses audio the students wear headphones while in lab, which reduces interaction among students. The lab has transformed to become an environment of individual learning. A semester group design project has helped to reintroduce interpersonal communication in the lab.

As the students are provided with full presentations of the lecture notes, more material can be covered during the lecture time. Students don't need to spend as much time copying information of the lecture slides since they are all available to them on the computer. On the negative side some student forgo the lecture for an individual reading of the lecture notes. Rather than fight this trend, work toward adding audio and video clips to the lecture presentations is in progress giving the student complete access to all the lecture material on their own schedule. Some of the same dynamics occur in the lab where students work on their own time rather than during the scheduled lab time. Quizzes given each lab period motivate students to attend the lab where they feel some accountability for turning in homework and keeping caught up with assignments.

The development of the CD has also impacted the future of the course. As stated previously the project has made it possible for the course to be offered on-line. This will especially be helpful for area high school students who are taking the course to have full access to the course material from their individual campuses. Although an on-line course offers more flexibility for students it restricts the flexibility of the course material. Significant changes to the course that require redevelopment of the material are avoided because of the investment of time involved.

How the Project Has Impacted the Students

The greatest positive impact that the project has had on students is they now use their time more efficiently. Labs are no longer filled with students with hands raised waiting for an instructor to respond. Instead, students work quietly and independently on their homework using the tutorial movies to answer their questions. Bright students use the tutorials as a backup when they encounter a difficult problem and quickly complete the assignments. Slower students follow the tutorials step by step and rarely need to ask for assistance. Both, however, learn the material and complete the homework assignments. Students who don't finish the work during lab can return any time to complete the assignments while still receiving instruction. The number of students who don't complete the homework or complete the assignments with errors has dropped noticeably. This has led to a slight improvement in the performance on exams.

The greatest negative impact that the project has had on students is that they feel less connected to the instructor and the engineering program. Contact with the instructor is primarily during the large lecture sessions, which meet weekly for 50 minutes. One consequence of this lack of connection is that unmotivated students are not personally encouraged and eventually drop the course. Many students need personal encouragement from an instructor who knows their name and periodically checks on their performance to succeed in a course. This will likely be more pronounced with an on-line course. One of the motivating factors for offering the course to area high school students is do draw future students into an engineering program that they feel connected to. This aspect of the project works counter to that goal.

There are a number of other notable effects of the project on the students. A student who falls behind because of uncontrolled circumstances is much more likely to catch up and perform well in the course. In the past this required a significant effort from the instructor and special meeting times had to be scheduled with the student. The visualization tools that are developed by the student as they interact with the game pages are invaluable to the student and difficult to teach using other methods. As the students visualize objects repeatedly in the games with positive and negative feedback they exercise a developing skill that would otherwise be tedious if done using a printed worksheet. By the end of the course the students have been exposed to a breadth of examples using interactive graphics to teach and communicate. The students seem motivated and intrigued by use of engineering graphics as a powerful communication tool whereas in the past they had a much narrower focus for the application of engineering graphics.

The Cost of Development

The development of an interactive multimedia teaching tool requires a significant investment of time. Assuming that the developer is familiar with the tools needed to create the project, which is significant assumption, the time invested in a project of this magnitude would be on the order of several hundred hours. Such an endeavor requires an extreme commitment of resources and energy far above those required for the development of a course taught using a traditional approach. The costs and benefits need to be carefully assessed before undertaking the development of a project of this magnitude (Turner, 1997, Ward & Newlands, 1998). The 62 tutorial movies on the CD were each recorded several times and cover several hours of instruction. The planning and recording of the tutorials required more than 120 hours. Putting the lecture presentations into a computer presentation format required approximately 4-5 hours per lecture. The bulk of the time was used to generate graphics used in the presentations. Future development of the lectures into multimedia presentations with audio and video is expected to take 8-10 hours per lecture with the exception of the first lecture. The first multimedia lecture presentation has been completed and required more than 40 hours to complete. The games each took 5-8 hours to design, write the JavaScript code, and generate the graphics. The quizzes could each be developed in less than an hour. Setting up the overall structure of the web site and linking the information is a relatively simple task.

Reliance on previous experience can greatly reduce the required investment of time. The first project has been duplicated in a very limited way and applied to another engineering course (Measurements and Instrumentation). In less than 30 hours a significant portion of the structure of the original project has been recreated for the new course. Handwritten lecture notes were scanned and saved as PDF files that are readable with a browser plug-in. Old exams and homework solutions have also been added to the site to give many of the benefits of the interactive quizzes for a fraction of the invested time.

Conclusions

The overall effect of a major change in pedagogy on the average student has been positive. The average student has adapted to the use of the multimedia instructional approach quite well with minor improvements in overall performance and depth of knowledge gained in the course. The most notable changes however, are associated with those who fall outside the range of average. Advanced students are stimulated by the self-paced nature of the course and stay motivated throughout the semester. Slower students can work at their own pace and finish a course that they might otherwise drop. There does appear, however, to be a group of students from the full intellectual spectra who do not perform well in an environment with there is little interpersonal connectivity with the instructor. A small section using traditional instruction could be added to address this problem.

The overall impact on the course has also been positive with a significant increase in the breadth of material covered and flexibility of delivery. With the completion of the multimedia instructional material the course can be easily exported off campus to area high schools students and to those who wish to take the course on-line for convenience. The scheduling flexibility for students taking an on-line course will likely increase enrollment as the course is an introductory level course.

The cost of developing the project was significant. Several hundred hours were required to bring the project to its current level. Justification for such a tremendous individual effort was based on the promise of teaching multiple sections of the course over several semesters. A scaled down version of the project has since been successfully been developed for another engineering course with a fraction of total time invested indicating that the pedagogical approach can be successfully adapted to other courses.

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From Algorithm Animations to Animation-embedded Hypermedia Visualizations

Steven Hansen, Daniel Schrimpsher and N. Hari Narayanan
Visual Information, Intelligence & Interaction Research Group
Department of Computer Science & Engineering
Auburn University, AL 36849-5347, USA
{hansensr,schridj,narayan}@eng.auburn.edu

ABSTRACT: The idea of using animations to illustrate dynamic behaviors of computer algorithms is over fifteen years old. Over a hundred algorithm animation systems have been built since then, with most developed in the belief that the animations would serve as effective learning aids for students. However, only recently have researchers started asking the question: Do algorithm animations really help? Unfortunately, results of experiments driven by this question have been disappointing. We believe that previous attempts at using animation to teach algorithm behavior were unsatisfactory not because of a flaw with animation as a technique, but because of the approach used to convey the animations. In this paper, we present a novel theoretical framework for the design of effective algorithm visualizations, one which espouses embedding interactive analogies and animations in a context and knowledge providing hypermedia environment. We then present the architecture of HalVis, an implemented system based on this framework, and results from five empirical studies that demonstrated the advantage of our framework over traditional means of instruction and extant algorithm animations.

Introduction

Over fifteen years ago, with the unveiling of the movie Sorting Out Sorting at SIGGRAPH-81, the idea of using graphics and animation to illustrate the dynamic behavior and functionality of computer algorithms was born. Algorithm animation appeared to hold great promise as an instructional aid, with many dozens having been built such as Balsa (Brown, 1988), Tango (Stasko, 1990) and their successors. Most were developed in the belief that algorithm animations would serve as effective supplements to lectures for students to learn about algorithms. This belief has a strong intuitive basis. Students have always had a relatively difficult time understanding abstract mathematical notions, especially when these included dynamics of how algorithms manipulate data, so concretizing these notions graphically and animating them to illustrate the dynamics ought to improve learning.

Though research on designing and deploying algorithm animations spans over 15 years, only recently have researchers started asking the question: do algorithm animations really help? Dozens of experiments have been conducted to test whether algorithm animations lead to improved understanding of algorithms. Hundhausen (1996) presents an excellent summary of the results of 29 empirical studies pertaining to the comprehension efficacy of algorithm animations and, more generally, software visualization. Unfortunately, all one can say about this accumulated evidence is that the results, at best, are mixed. While animations are enthusiastically received by the students, none of the studies has proven conclusively that these visual presentations actually *improve* learning (Badre, 1991; Byrne, 1993). The following quote succinctly expresses the frustration felt by researchers working in this area: "Unfortunately, the viability of algorithm animations as instructional aids remains rooted in intuition. No substantive empirical evidence has ever been presented to support these claims" (Stasko, 1993). Is this because animation is an ineffective teaching tool? Intuition tells us this is not likely.

Rethinking Algorithm Animations--From Animations To Visualizations

Research presented here is based on the premise that animations are indeed useful. We believe that previous attempts at using animation to teach algorithm behavior were unsatisfactory not because of a flaw with animation as a technique, but because of the approach used to convey the animations. Hence, a rethinking of algorithm animation design is required in order to harness its power to enhance learning.

Theoretical foundations of our approach to algorithm visualization are rooted in several areas: (i) a comprehension model derived from research on how humans reason using static diagrams to infer the dynamic behavior of mechanical devices and its application to the design of hypermedia machine manuals (Narayanan, 1998), (ii) recent research in cognitive and educational domains on how multimedia and hypermedia can improve student comprehension (Crosby, 1995; Daily, 1994; Kehoe, 1996), and (iii) extant research on the design and evaluation of algorithm animations (e.g., Byrne, 1996; Kehoe, 1996; Lawrence, 1994; Stasko, 1997; see Hundhausen, 1996 for a comprehensive overview). Drawing from these sources, we have developed a framework for the design of algorithm visualizations called HalVis (**Hy**permedia **Al**gorithm **Vis**ualizations) and a corresponding software system. The key idea is to embed algorithm animations at various levels of abstraction inside a hypermedia environment. Distinctive features of HalVis and their rationale are described below.

- Learning Objectives: Algorithm visualization design starts with a top-down process in which explicit learning objectives (e.g., understand the central metaphor such as that of values "bubbling up" in BubbleSort, understand core operations of the algorithm such as swapping data values during sorting or pivot picking in QuickSort, etc.) are used to divide, describe and deliver information. The approach is learner-centered ("what do students *need* to know") rather than technology-centered ("what *can* we show"). In HalVis, the focus is not on the animations but rather on the orchestration of various hypermedia elements to meet the educational objectives, leading to effective visualization.

- Scaffolding: The learning process begins using real world analogies (e.g., animated playing cards that illustrate sorting and merging in MergeSort) intended to provide a basic conceptual understanding of the essential elements of the algorithm. These analogies serve the purpose of "scaffolding" (Hmelo, 1996) and are a natural prelude to subsequent learning. Douglas (1995) and Stasko (1997) have shown that when students are asked to design algorithm animations, they employ real-world metaphors such as a football game or flying spacecraft. In HalVis, the analogy introduces the algorithm, and then the gap between the analogy, the abstract components of the algorithm, and the concrete graphical representations used in other modules to depict the algorithm's behavior is bridged. Bridging is intended to facilitate comprehension of algorithm animations by allowing the learner to internally connect the analogy and the animation. All this occurs *prior* to showing any algorithm animation. We believe analogies set the stage for subsequent detailed learning, help improve long-term retention, and lead to better visualization.

- Chunking: Given the big picture, learning can proceed to the details. Unfortunately, current algorithm animation systems present the detailed dynamics of the algorithm as a one-shot, stand-alone show that is entertaining to watch but tends to obscure the very details the student needs to learn. Research on cognitive media types (Recker, 1995) points to the importance of using different types of information (definitions, examples, etc.) in teaching algorithmic concepts. Kehoe (1996) have also pointed out the importance of multiple representations and media, concluding that text is important for precision, pseudocode is useful for conveying steps of the algorithm, and animations are good for depicting operational behavior. HalVis uses a technique called "animation chunking" in which animations are broken up into meaningful bite-sized pieces. Each chunk is presented in synchrony with other representations (e.g., feedback in a text window, pseudocode with relevant lines highlighted, aural explanations) of the specific actions taking place. These are embedded within a hypermedia structure that provides contextual knowledge using hyperlinks to additional explanations using text, audio and pictures. Combining, synchronizing, and presenting information in multiple media in discrete chunks is more than animation; it is visualization.

- Granularity: Three distinct kinds of animations provide views of algorithm behavior at different levels of granularity. One is an animated real-world analogy intended to function as a scaffold and a bridge by conveying the essence of the algorithm. The second is a detailed micro-level animation that focuses on specific algorithmic operations. The third is a broader macro-level animation that shows the algorithm's behavior on large data sets. The detailed animation is chunked at multiple levels (e.g., at the level of a single instruction execution, at the level of a "pass" for algorithms that make multiple passes over data). Each chunk is presented in tandem with pseudocode highlighting and textual/aural explanations. The learner can elect to see the animation at any of the available chunking levels. The micro-animation is presented before the macro-animation, both of which are seen by the learner only after the animated analogy. This sequential design is intended to address a particular difficulty uncovered by an earlier study that stated, "a paradoxical problem with the animation is that it shows the big picture or emergent qualities that might be appreciated only by those that already understand the algorithm at the mechanical level" (Byrne, 1996).

- Rich Interactivity: Most educators agree increased student interaction improves learning. Experiments conducted by Lawrence (1994) indicate a learning advantage for students who had active involvement in the creation of input values to algorithm animations. In contrast, research in different domains indicates that passively watching an animation may not facilitate learning (Rappin, 1997; Stasko, 1993). In HalVis, all animations allow active intervention by the learner. Besides the usual replay and speed controls, HalVis allows and even encourages students to alter the data and rerun the animations to see how the algorithm performs on data sets of their own choosing. Students can also make predictions about performance to compare with actual results. Increasing the level of interaction leads to better visualization.

- Critical Thinking: A potential problem with multimedia presentations is often stated as "hands-on, mind-off," where the interactions engage the user so much that analytical thought about the content of the presentation is inhibited. HalVis employs two kinds of probes to avoid this syndrome. One, called "ticklers," are questions that pop up in random order, but always in an appropriate context, and can be dismissed by the user. These are questions that require considerable mental effort in the form of self-explanations (which have been shown to promote comprehension (Chi, 1989), but the system makes no effort to enforce answering them. The other kind, which we call "articulation points" involves questions the user must answer before proceeding, and the system provides immediate feedback about the correctness of the answer. These questions are tied to learning objectives set out by the designer and help students self-diagnose their learning and allow them to reflect on what they know, what they don't, and where to find relevant information.

HalVis Architecture

We have created a prototype system, called HalVis, to test the components of the framework described above. HalVis is implemented using Asymmetrix Toolbook, and as of this writing, contains visualizations of four sorting algorithms and one graph algorithm. Each visualization in HalVis consists of the modules shown in Figure 1 and described below:

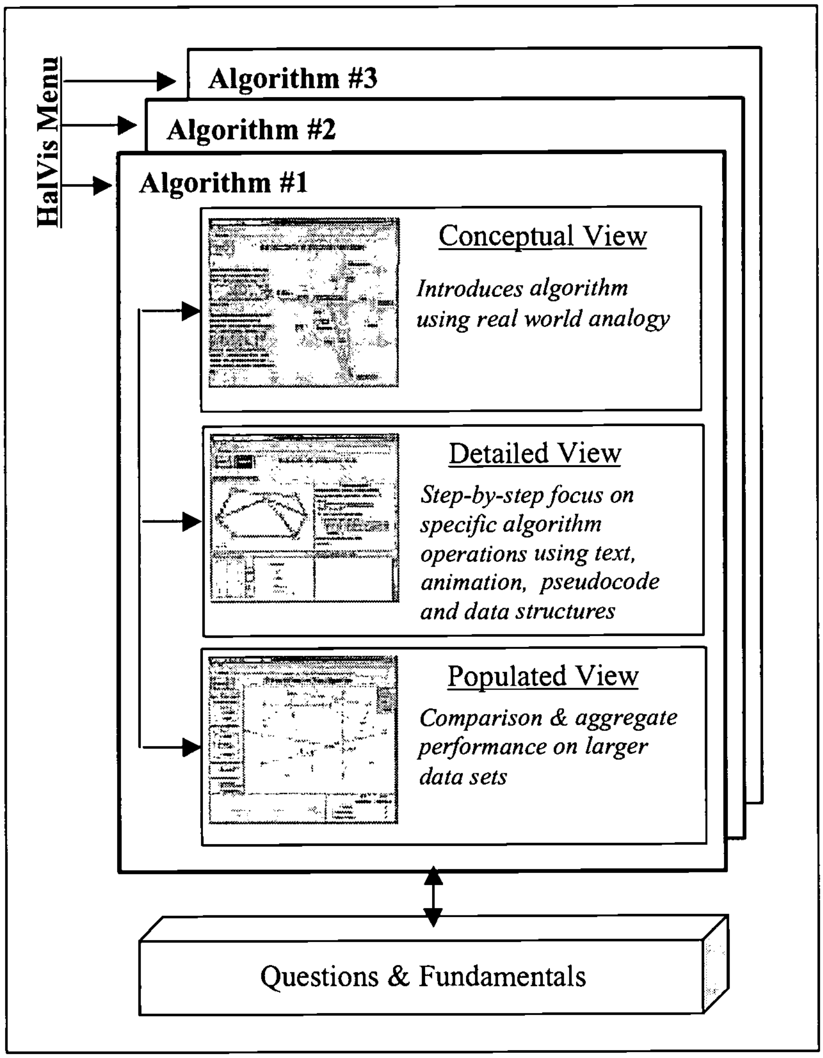

Figure 1. HalVis Architecture

- Conceptual View: This module introduces a specific algorithm in very general terms using a real world analogy. For instance, BubbleSort is introduced using a flask of water with bubbles that rise to the surface according to their size and the Shortest Path algorithm uses a simple game that allows the student to observe a map of airline fares through various cities and select the route with the cheapest fare to illustrate the basic working of the shortest path algorithm. This module uses animations, text and audio to provide the student with a general overview, a visual example to aid long-term retention, and sufficient bridging information to help learners proceed from the visual elements in the analogy to the data structures and algorithm operations in later modules.

- Detailed View: This module contains two screens. One consists of a detailed textual description of the algorithm alongside a pseudocode representation of it. Embedded in the text are hyperlinks to related information in the Fundamentals module. The second screen, shown in Figure 1, contains four windows that depict various aspects of the algorithm's behavior. The Execution Animation window shows how steps of the algorithm modify data structures using smooth animation. The animation is chunked at multiple levels of granularity corresponding to meaningful units of the algorithm's behavior, and can be altered by the learner. At the lowest level, the animation displays the execution of an individual statement, pausing for the learner's signal to proceed. The next level corresponds to a logical operation, like completion of a single pass in a loop. At the highest level, the animation proceeds to completion without pausing. The Execution Status Message window provides comments and textual feedback to the student about key events and actions during execution. This is also available as an audio commentary. The Pseudocode window shows the steps involved in the algorithm, which are highlighted synchronously with the animation. Finally, the Execution Variables window contains a scoreboard-like panorama of the variables involved in the algorithm and their changing values. Before launching the animation, students can change the data input to the algorithm as well as the speed and granularity of animation and feedback. Execution of each step of the algorithm affects the display in the four windows simultaneously. The thumbnail in Figure 1 shows a seven vertex graph used in the Shortest Path algorithm. HalVis intentionally limits the number of data items in the Execution Animation window to focus attention on the micro-behavior of the algorithm.

- Populated View: This module is intended to provide students with an animated view of the algorithm on large data sets to make its macro-behavior explicit. Many of the details presented in the detailed view are obscured to enhance the student's focus on the algorithm's performance. For example, the pseudocode is not shown, nor are variables. Animations in this module are similar to those in extant systems, but there are two novel features. One is a panel of counters that show pertinent performance-oriented information such as number of comparisons, swaps, recursive calls, and so on. Another is a facility for the student to make a prediction about different parameters of algorithm performance and then compare those against the actual performance when the animation is running. When the learner launches the animation, the system prompts for predictions, creates a random initial configuration, and proceeds to move the graphical representations accompanied by audio explanations and cues.

- Questions & Fundamentals: The Questions module presents the student with a combination of multiple choice, true-false, and algorithm debugging (by reordering the steps) questions to measure competency and comprehension, and the system provides immediate feedback on student responses. HalVis also pops up context-sensitive tickler questions to help focus student attention on key aspects of the algorithm. The Fundamentals module contains information about basic building block topics common to virtually all algorithms. Examples include Comparing & Swapping Data, Looping Operation, Recursion, and so on. Generally, this module is accessible only through hyperlinks from other modules, so that the basic information is presented *on demand* (in response to a learner request in the form of clicking on a hyperlink) and *in context* (of algorithm-specific information within which the hyperlink is embedded).

Experiments With Hypermedia Algorithm Visualizations

We conducted a series of five experiments to evaluate and substantiate the effectiveness of hypermedia visualizations of algorithms, specifically to validate our hypothesis that visualizations will be more effective than traditional teaching methods for students learning about algorithms. In each of the experiments, subjects took a pretest to measure prior knowledge, learned the algorithm using HalVis or a traditional method, then took a posttest that measured knowledge improvement. Students were tested on their ability to recognize and reorder pseudocode descriptions of algorithms, mentally simulate algorithmic operations, and predict resulting data structure changes. In these studies, we did not differentiate between visual and verbal learners since HalVis contains rich textual and visual presentations to support both kinds of learner dispositions.

Table 1 lists information about these experiments, showing the student level, the materials used by the two experimental groups, the algorithm(s) studied, and the statistical significance of results. The first two experiments were described in detail in (Hansen, 1998). Experiment I showed that hypermedia visualizations are more effective than textbooks for learning about algorithms. This result was successfully replicated in Experiment II using more advanced students. Experiment III compared learning from HalVis to learning from a compilation of the best algorithm descriptions (extracted from 19 textbooks published between 1974 and 1997) followed by problem solving activities. While the posttest averages favored the HalVis group, the difference is not statistically significant. This experiment indicated that interactive visualization can be as effective as learning from carefully crafted text, when that textual learning is *followed* by problem solving.

Experiment	Student Level	Comparison Groups (average posttest scores)		Algorithm(s) Studied	Statistical Significance
I	Sophomore	HalVis *(74%)*	Text *(43%)*	MergeSort	$F(1,27)=10.9$ $p<0.015$
II	Junior	HalVis *(63%)*	Text *(44%)*	MergeSort QuickSort	$F(1,21)=4.9$ $p<0.038$
III	Sophomore	HalVis *(61%)*	Text + Exercises (57%)	BubbleSort SelectionSort	$F(1,24)=0.3$ $p<0.57$
IV	Sophomore	HalVis *(70%)*	Lecture *(44%)*	SelectionSort MergeSort	$F(1,19)=5.3$ $p<0.033$
V	Junior	HalVis *(89%)*	Text + Animation *(71%)*	ShortestPath	$F(1,37)=12.8$ $p<0.001$

Table 1. Summary of Five Experiments Conducted in This Research

Experiment IV was designed to compare and evaluate how algorithm visualization (AV) and conventional classroom lectures interact and contribute to student learning. Our hypothesis was that AV alone would assist learning more than a lecture. If so, it follows that AV used in conjunction with lecture should assist learning even more. We used a 100 minute live classroom lecture by a computer science faculty known for his teaching ability, delivered in two consecutive class sessions. Participants were second year computer science students at Auburn University, divided into two matching groups. One group used HalVis before attending the lecture (called the visualization-lecture (VL) group) and the other group used HalVis after the lecture (called the lecture-visualization (LV) group). Having both groups attend the same lecture eliminated variations that can occur in different sessions, while allowing interactions with the teacher. A first posttest was given between the two phases, and a second posttest was given after both phases. The first posttest results indicated that the VL group learned significantly more than the LV group; following the session with HalVis, the VL group's average score was 70% compared to 44% for the LV group. However, the second posttest results showed that after receiving both the lecture and the visualization, both groups performed at the same level (72%). These results suggest that visualizations can have a significantly higher learning impact than a lecture, and that a combination of both is even better.

Experiment V compared the effectiveness of learning from HalVis to learning from an algorithm animation typical of extant research on this topic. One of the most mature, widely reported, and publicly available algorithm animation platforms is the Tango software suite developed by Stasko (1997). The Tango software distribution contains a library of animated algorithms, including eight animations of the Shortest Path algorithm. Of these eight, we selected one that appeared to be the most complete, easiest to understand, and which most closely matched the features of the HalVis system, as a representative animation. One group of students interacted with HalVis and the other group interacted with the Tango animation. The second group was also provided with a textual description of the algorithm, to which the HalVis group did not have access. On the posttest, the HalVis group averaged 89% while the Tango group averaged 71%, indicating that a hypermedia algorithm visualization is more effective than an algorithm animation.

Conclusion

Collectively, these experiments provide initial statistical validity to the hypothesis that hypermedia algorithm visualizations can be significantly more effective than traditional teaching methods considered in isolation. More details of these experiments are available in (Hansen, 1998). There are a number of possible reasons for this effectiveness. First, in comparison with previous animation systems that only presented animations with some textual feedback, HalVis allows the student to learn incrementally by starting from a real world analogy and transitioning to the algorithm itself. Second, the hypermedia structure allows a student access to fundamental building blocks of algorithmic knowledge in-context and on-demand. Third, the top-down learning objective based design approach and the hypermedia structure have allowed us to divide information into manageable pieces and present each chunk using the most appropriate media. Fourth, rather than providing an animation all in one piece as has been the typical approach, HalVis presents three kinds of animations in an analogical-detailed-abstract sequence. Fifth, animations are delivered at multiple levels of granularity. This animation chunking makes it easier for students to pause, repeat, reflect, or access other relevant information through hyperlinks while watching animations. Furthermore, animation chunks are presented in synchrony with other representations. These two unique features, we believe, result in the dynamic information being conveyed better in context, and therefore in a more comprehensible fashion. Sixth, animations allow both active intervention and performance prediction by learners, both of which can improve comprehension. Seventh, we believe that questions that pop up in context in different parts of HalVis promote reflection and self-explanation, contributing to learning. Future studies will selectively analyze these features in order to identify those that contribute most to learning. More information on this research is available at our group's web site: http://www.eng.auburn.edu/cse/research/vi3rg/vi3rg.html.

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Learning Strategies: A Framework for Understanding Students Learning with Computers

Terry Di Paolo
Institute of Educational Technology
The Open University
Great Britain
t.dipaolo@open.ac.uk

Abstract

The last two decades have seen a significant increase in both the development and usage of computer based learning technology in tertiary education. Many researchers in the field of education have begun to develop an understanding of student learning in terms of learning strategies. Such constructs represent behaviours and thought processes adopted by the student and are believed to mediate learning. At present, however, little is known of the impact that computer based learning technologies have on these strategies.

This paper outlines various developments in our understanding of student learning in terms of styles and strategies that have occurred over the latter half of this century. The paper focuses on a learning strategies framework developed in the United States and its initial use as an evaluation tool for courseware in a distance education setting in the UK. Preliminary findings from this initial study designed to investigate the learning strategies users adopt when using a piece of courseware are also described along with plans for a future large scale study.

Introduction

Increasingly, educators and researchers acknowledge that learning strategies comprise some of the active processes that need to be examined to gain a better understanding of how students learn. At the same time educators are turning to software developers to offer computer based solutions to material that has proved difficult or unsuccessful in the traditional educational setting. In turn software developers are utilising more sophisticated forms of media (Jonassen, 1988). An increasingly popular option, especially with the natural sciences, is the computer simulation. Advances in both hardware and software, have meant increasingly sophisticated simulations becoming common computer-assisted learning (CAL) tools. Dating back to the late 1970's, simulations have provided the student with a meaningful environment within which they can interact with physical objects or scenarios from the real world (Thurman, 1993).

The research discussed in this paper examines a resource based learning tool, "The Human Brain" CD-ROM, which makes use of simulations. The research aims to explore this tool in terms of students' learning strategies. This form of evaluation, where students' learning strategies are the focus of the investigation, has almost exclusively been neglected in favour of one that determines the usability or effectiveness of the software. Yet, arguably, notions of usability and effectiveness are dependent on the learning strategies employed by students. The evaluation is intended to provide insight into the success and limitation of the software in terms of both usability and effectiveness. The research has also aimed to examine the stability of student learning strategies over the duration of an academic course and explore whether learning strategies differ as a function of the learning medium students use on the course, i.e. computer based versus non-computer based.

In the following sections the notions about and measurement of learning strategies will be described with a history of how educational researchers, predominantly in the States, have come to understand student learning in terms of such constructs. Evaluation at the UK Open University (OU) will then be outlined briefly, demonstrating the current consideration given to learning processes in CAL evaluation. The paper will then describe a pilot study undertaken in 1998 to investigate the learning strategies of student learning with a computerised resource based learning tool.

Background Literature

Learning Strategies

For many years educational researchers have sought to determine and understand the learning processes adopted by students in tertiary education. Much of this work has been influenced by psychological theory. In the last fifty years or so, the field of psychology has been dominated by an interest in cognitive processes. With this impetus and also an increasing understanding of personality and personality typologies, researchers began to investigate whether differences existed in the ways individuals approached everyday information processing. Differences were found which indicated a series of consistent approaches to the organisation and processing of information which came to be termed cognitive styles (Tennant, 1988). Attempts have been made to examine such differences in the context of the university setting. However, according to Messick (1981, 1984) they have generally proved unsuccessful because of problems associated with the definition and measure of cognitive style.

By the late 1960's researchers began to acknowledge that learning in the university setting differed from everyday learning processes. Work carried out predominantly in Europe during the 1960's and 1970's proposed the notion of student learning styles. As a construct, learning style generally referred to one of a finite number of learning dispositions that students adopted in their pursuit of a degree qualification. It also incorporated the notion of both cognitive and motivational processes impacting students' learning behaviour. For example, a student who was intent on gaining a high level understanding of the information being learnt and was motivated to do so by a personal interest in the subject matter could be categorised as adopting a deep learning style (Marton and Saljo, 1976). In contrast, a student who was preoccupied with meeting the assessment aims and requirements of the faculty and whose main concern was to learn the required information by methods of rehearsal or rote memorisation could be categorised as adopting a surface learning style.

The term "learning style" has come to be used both synonymously with, and in contrast to, the terms "learning approach" and "learning orientation". This confusion with regards to terminology is associated with problems of definition regarding what behaviours or processes the construct of learning style actually refers to. Terminology regarding learning style and definitions of the construct have become convoluted, in part, because of a common aim held by researchers in the field - to increase our understanding of student learning by determining individual differences in the manner in which students learn. Confusion has arisen because a great number of individual differences have been found to exist amongst learners, yet researchers report their findings as definitive and finite. Attempts have been made to classify the various findings in the field, but even these systems present little agreement over the classification of findings from over thirty years of work (see Murray-Harvey, 1994).

In recent years there has also been an increasing amount of debate about the benefit of learning style as a measure of learning behaviour in tertiary education (e.g. Mitchell, 1994). It has been proposed that such notions of learning preferences and habits may not take into account variation in the learning behaviours and processes that occur in response to university teaching (McKeachie, 1998). The work of McKeachie and his colleagues at the University of Michigan, like many others, represents a move away from the classification of learners towards the classification of learning according to a series of constructs termed learning strategies (Pintrich, McKeachie and Smith,1989). Pintrich et al propose a framework of learning strategies based in part on the work of Weinstein et al (1987).

Weinstein and Mayer (1986) provide a definition of learning strategies as:

> "behaviours and thoughts that a learner engages in during learning and that are intended to influence the learner's encoding process...the goal of any such strategy is to affect the learner's motivational or affective state, or the way in which the learner selects, acquires, organises, or integrates new knowledge" (p315)

Learning styles provide a classification of the student, for instance, as in the examples provided earlier. Learning strategies present a departure from this method, instead learning is seen as comprising a series of components or constructs that relate to motivational and cognitive aspects of learning behaviour. The student is seen as using each of these strategies to a varying degree, for example they might be highly extrinsically motivated and make good use of an organisational strategy. There is no categorisation of the student, merely a profile of their learning behaviour, a profile of the extent to which they use a particular set of strategies.

In attempting to measure student learning strategies Pintrich et al (op cit), have developed the Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ is based upon a theoretical framework comprising a series of assumptions about learning in both the academic and real world which assumes the use of a maxinum fifteen strategies (McKeachie, 1990).

The team claim that students construct knowledge on the basis of that which they already know. It is also suggested that students' ability to remember and utilise what they have been taught depends on the level to which they process the material they have learnt. Finally, they propose that human beings are inherently learning creatures but intrinsic interest can be weakened by a sense of hopelessness about one's competence as a learner.

Arguably, the MSLQ's most important and valuable attribute is that it acknowledges that strategies are subject to change amongst courses and sets out to measure strategies specific to courses and course components. For the purposes of the planned research, this is an extremely valuable attribute of the MSLQ. This research endeavours to assess the impact of educational software on students' learning strategies. It aims to examine the learning strategies students come to use when using a resource based learning tool - "The Human Brain" CD-ROM.

The framework for establishing the nature of these strategies has been informed by the constructs measured by the MSLQ. Comparisons and distinctions are intended to then be drawn between learning strategies used whilst working with the CD-ROM tool and other teaching materials, predominantly text-based, on the course. This comparison may appear problematic since the two comprise very different mediums, but the comparison being made is not one of learning outcome: whether there is a difference in the quantity or quality of information that is learnt between computer based and non-computer based materials. Rather, the research intends to ascertain whether a different or similar set of strategies mediate learning with computer-based and non-computer based learning materials. This is important, since learning strategies vary in the context of learning domains based upon the specific learning requirements of the domain and previous learning experience. To that end, one of the aims of this research is to determine whether the learning processes for the course overall feed into the learning strategies the students then come to use in using the CD-ROM.

The design of "The Human Brain" CD-ROM was prompted, in part, by the difficulties reported by past students in comprehending the material in traditional text or two-dimensional pictorial format. Generally, where educational software has been made available it forms an important course component, yet very little research has examined the technology in terms of students' learning strategies. At the Open University evaluation studies have embraced the study of users' learning processes but not included learning strategies in their assessments.

Most of the courseware developed at the UK Open University, like "The Human Brain" CD-ROM have been produced to supplement or complement various science courses (see Jones et al, 1996). For example, The Works Metallurgist has been designed to help students with problems experienced in interpreting phase diagrams. Another example, the Driven Pendulum assists students with their understanding of the physics of motion. Increasingly though, Arts based subjects are also drawing on computer based resource learning tools. One example, is the course: Charles Booth and Social Investigation in the Nineteenth Century which introduces the computer as a tool for historical research. It allows students the opportunity to use and construct their own historical databases from a number of archive resources digitised and stored on CD-ROM.

Evaluation experience from such courseware and other projects has framed the development of an evaluation framework, CIAO! (Context, Interactions, Attitudes and Outcomes), by the Computers and Learning Research Group at the OU(Jones et al, 1996). The framework is intended to provide the evaluator with a variety of methodological tools instead of a limiting set of prescriptive measures. The framework has been used to evaluate courseware on a number of courses taught at a distance by the OU. It proposes three facets, or dimensions that the evaluation process should come to incorporate and integrate: context, interactions and outcomes.

At present, the CIAO! framework proposes, in part, that the process of evaluation takes into account various learning behaviours students exhibit when using courseware. The notion of various learning strategies as proposed by Pintrich et al would provide definition and more importantly a framework for understanding precisely what these learning processes are.

The Pilot

The review above has sought to identify a need for viewing students' learning in terms of learning strategies and, with the growth of computer based resource learning tools, to examine learning with these tools in terms of learning strategies. In the past, student learning has been considered in terms of style, initially cognitive style and subsequently learning style. These conceptualisations view the learner as a creature of habit whose learning behaviour falls into a limited set of categories, e.g. deep approach, surface approach. Increasingly, though, this classification of learners is being replaced by an examination of their learning behaviour in terms of learning strategies.

The notion of learning strategies accepts that learning behaviour is subject to change in response to the demands of the learning situation, with the characterising feature of these constructs being not the classification of the learner but of their behaviour. Over the years a series of learning strategy frameworks have been developed. For the purposes of the research presented in this paper the framework developed by Pintrich and his colleagues has been chosen as the method by which to identify the learning strategies that students on SD206:Biology: Brain and Behaviour course come to use. The framework identifies fifteen learning strategies and measurement is made of the extent to which each of these is utilised or adopted by the learner. What results is a learning profile of the learner as opposed to the characteristic classification of the learner that occurs with cognitive style and learning style measures. This profile is relevant only to the learning situation in question, i.e. the study of a particular course that forms part of the degree award, since learning strategies are sensitive to learning contexts and different courses present different learning contexts.

The use of computer assisted learning (CAL) tools also presents a different learning context and the purpose of the current research is to examine the impact of that context on student learning processes - their learning strategies. The research proposed here is thus framed by a series of issues which arise from the literature examined in the previous sections. Firstly, much of the work on learning strategies and the resulting frameworks have been carried out in the US on students studying in traditional tertiary education. The research has sought to examine, in part, how comparable those findings are to a British sample studying at a distance.

There has also been little work on the stability of learning strategies over a short period of time. The constructs are said to be sensitive to context, but over the period of a course there may be other factors, for example assignments or the onset of assessment, that impact the strategies that students come to use. Thus, the research has also sought to examine the stability of students' learning strategies. This idea of context impacting upon learning processes leads to the important question of whether students' learning strategies change as a function of the medium that they come to use whilst learning? That is, would the option of using a computer based learning resource bring about changes or differences in the strategies students use when learning with traditional text, video and audio material. The answer to this question, however, is dependent on knowing what learning strategies students employ whilst learning with a computer assisted learning (CAL) tool. For the purposes of this study a piece of courseware developed at OU has been chosen as the piece of software to be investigated in terms of students' learning strategies. The pilot is intended to provide an understanding of the learning strategies used by students undertaking a course at the OU where there is the option of using a CAL tool to complement traditional teaching materials. The aims of the intended research are two-fold and comprise two research phases. The first phase serves to apply the MSLQ to a distance education setting and to examine the stability of the learning strategy measures over a distance of approximately two months.

Developed in America, the MSLQ is a self-report instrument designed to assess college students' motivational orientations and their use of different learning strategies for a specfic college course. The questionnaire comprises 81 items, each scored on a seven point Likert (1=not at all true of me and 7=very true of me). Motivation is measured by six subscales: intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test anxiety. Learning strategies are measured by nine subscales: rehearsal, elaboration, organisation, critical thinking, metacognitive self-regulation, time and study environment management, effort regulation, peer learning and help-seeking. The fifteen subscales are designed to be modular, that is measurement of all or specific strategies can be made dependent on the needs of the researcher or instructor for the course in question.

In this study the course that students have been selected from is a second level 60 credit course run at the OU - SD206: Biology: brain and behaviour. The course aims to teach students neurobiological structure and functioning and was chosen because students have the option of using a computer based resource learning tool - The "Human Brain" CD-ROM. The CD-ROM has been developed in-house at the OU by the Biology Multimedia Group. Its main purpose is to marry together the teaching of neurobiological functioning and structure in a medium that is able to present detailed information in a format that is easy to use and affords understanding. The tool is anticipated to provide approximately 30 hours of study time. It makes use of various features including narration, text, video, animations. Navigation is such that each topic is organised into three levels of increasing complexity. The topics the tool covers include: general aspects of the central nervous system, the cerebral cortex, the spinal cord, vision, hearing and speech. The tool also allows the student to assess their knowledge via a series of multiple choice questions. The second phase aims to examine the learning strategies students adopt when using the CD-ROM produced for SD206.

In June of 1998 an amended version of the MSLQ, measuring all fifteen subscales, was posted to a sample of 471 students studying the SD206 course. After a period of two months those that responded to the first questionnaire, 306 students, were sent the questionnaire again. From this second posting 96 cases have been matched; of these, approximately half are using the CD-ROM. This exercise, in part, aimed to explore the learning strategies of students in their general study of the course. Amendments made to the questionnaire included changes in terminology (e.g. class, instructor) to make the questions applicable to students studying at a distance. Also each question incorporated the course code, the common referencing term for the course being studied. It was intended that this tactic would direct the responses of students to the course in question in lieu of the cues suggested by Pintrich and Garcia. For example:

> Original Question - *In a class like this, I prefer course material that really challenges me so that I can learn new things*
>
> Revised Question - *I prefer course material for SD206 that really challenges me so that I can learn new things*

From this intial phase the results indicate relatively high correlations between the subscales on both questionnaires. This would seem to indicate a fair degree of reliability and stability in the subscale measures. In examining the subscale scores, findings indicated that students taking the course are highly motivated and making good use of learning strategies in their study. In many respects the results of this distance education sample mirror the results of students studying via traditional methods in American colleges. Also, at this early stage, those using the CD-ROM indicate that the tool is easy to use and praise its development.

The second phase of the research is intended to build on the intial phase and its findings and explore the strategies that students adopt in using the CD-ROM. This next step will be to observe and interview students using the tool and identify the strategies they come to use based on the framework developed by Pintrich et al.

Conclusion

Our understanding of student learning has undergone a series of changes, from initial notions of cognitive style and learning style to the present day emphasis on examining student learning strategies. Measures of style are still common today but the extent to which they help us understand the complexity of student learning remains uncertain. Learning strategies present a move away from the classification of learners towards a classification of learning. Currently, evaluation practice fails to adequately understand the nature of the user's learning processes. The current research serves to remedy this by implementing a learning strategies framework in the evaluation of learning processes that occur whilst learning with a computer. It is intended that the subsequent research findings will inform not only evaluation practice but also courseware design.

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A Process for Improving Web Site Accessibility for People With Disabilities

Eric G. Hansen
ehansen@ets.org
Douglas C. Forer
dforer@ets.org
Daniel H. Jacquemin
djacquemin@ets.org
Educational Testing Service, Princeton, New Jersey
United States

Abstract: There is a great need to improve the accessibility of Web sites for people with disabilities. This paper suggests a five-step process, drawing upon our experience at Educational Testing Service (ETS). For each step, we offer suggestions. The steps are: (1) Initiate a Web accessibility project; (2) Identify accessibility problems using automated tools and human evaluators; (3) Identify possible solutions, such as providing education and training, making available templates and examples, utilizing new technologies, and forging relationships with outside experts; (4) Select and implement a solution; (5) Obtain support for continuous improvement. In practice, these five steps may be somewhat concurrent and may be repeated.

Introduction

Many Web sites are partially or completely inaccessible to people with disabilities. For example, many Web pages implement graphics and audio clips in ways that are inaccessible to people with visual and hearing disabilities. Also, the written text on many Web sites uses language that is unclear or unnecessarily complex, making it inaccessible to some people who have language-related disabilities, such as cognitive disabilities, learning disabilities, and deafness.

Fortunately, Web developers can make their sites accessible to people with disabilities. For example, pages with images can be made accessible to people who are blind if appropriate text alternatives are provided. For instance, if a Web page uses an image of a flower, the Web developer can insert a text description of the flower into the "alt" attribute of an image (IMG) element. The Web user who is blind can then use speech output technology to hear the text alternative. By making this and other provisions, Web developers can ensure that Web sites are accessible to people with a variety of disabilities, including blindness, deafness, deaf-blindness, and many other disabilities.

However, it is not necessarily easy to change current Web development practices within an organization. Web site development in many organizations is a complex undertaking involving many individuals and teams.

Individuals who take the role of change agent need to be aware of the how best to balance the technical, educational, and advocacy aspects of the role. Such individuals can benefit from learning how others have attempted to address the challenge of improving Web site accessibility within their organizations.

Background

The main Web site of Educational Testing Service (ETS), "ETS Net" (www.ets.org), became available to the public in May 1996. The site includes links to other sites, such as those of the Graduate Record Examinations® (GRE®) program, the Advanced Placement Program® (AP®), the Graduate Management Admission Test® (GMAT®) program, the College Board®, and others. These sites provide information on how to prepare for tests, how to register for them, and how to obtain special accommodations (extra time, a sign language interpreter, etc.). Other features of ETS sites may include online registration, practice tests, and financial aid information.

Several ETS staff expressed an interest in ensuring that our Web sites were accessible to all users. We did not possess, individually or collectively, all the expertise needed to guide the corporation in achieving this goal. We determined that it would take a specific project to pull together the expertise and resources with which to ensure the accessibility of our Web sites.

In mid-1996 we sought and obtained internal corporate support for the ETS Web Access Project and began organizing our team. From then until now (March 1999) we have carried out a number of activities. On the basis of our experience with these activities, we feel that we can offer suggestions that may be useful to others who see similar needs in their organizations.

Purpose

The purpose of this paper is to describe a process that an organization can follow to improve the accessibility of its Web sites.

Method

The method for describing the process is to break it down into five steps, as follows: (1) Initiate a project; (2) Identify accessibility problems; (3) Identify possible solutions; (4) Select and implement a solution; (5) Obtain support for continuous improvement.

At what point in this process is ETS's Web Access Project? It is difficult to say. Since the project is under consideration for its third year of funding (from ETS Research), one would judge that we are in step five. The fact that we are beginning to implement some solutions suggests that we are in step four. Yet in other areas we feel that we are very much at the beginning (step one). Thus it is difficult to characterize the entire project as being at a single point in the process. We hope that, notwithstanding these ambiguities, the five-step process will serve as a useful framework for organizing our suggestions.

The Process

1. Initiate a Web Accessibility Project

There are several activities that may help an organization launch a Web accessibility project.

Communicate the Benefits

Making Web sites accessible is a practical step toward providing "equity" and "access" in the delivery of products and services. Improving accessibility of Web sites will also benefit many individuals, beyond those who have disabilities. An example of "side-benefits" for nondisabled people is found in the case of curbcuts on sidewalks. They were intended primarily to benefit individuals with wheelchairs, but they also benefit parents pushing strollers, people temporarily on crutches, and older people for whom stepping on or off a curb is difficult. Following accessibility guidelines in Web sites will similarly benefit many individuals who do not have disabilities, including individuals with slow modems (who often use the Web with the graphics turned off), text-only Web browsers, or telephone-based browsers (which use Touch-Tone signals for input and provide audio output). The work would also benefit individuals who use search engines, which generally rely on indexing of text to find Web content. Thus, in addition to just being the right thing to do, improving accessibility of Web sites can increase the base of clients who are able to use an organization's products and services.

Obtain Organizational Support

Obtain support from the organization. Our project has received internal research -area funds for the past two years and will, hopefully, do so for a third year. As the effort continues, we hope to find additional sources.

Ensure Wide Representation on the Project Team

Ensure that the project team includes individuals with a variety of expertise and backgrounds. The Web Access Project team has included members from different areas within ETS. Areas of expertise represented include publishing (paper and electronic), systems analysis, instructional design, disability access, research design, and other domains. Individuals with disabilities , such as those with blindness, serve as team members and consultants on the project.

Review Existing Accessibility Guidelines

Review existing guidelines for Web accessibility. The most authoritative document on the subject is the "Web Content Accessibility Guidelines," which is a proposed recommendation of the World Wide Web Consortium (W3C) (Chisolm, Vanderheiden, & Jacobs, 1999).

2. Identify Accessibility Problems

Identify and document accessibility problems according to a systematic evaluation methodology, using both human evaluators and automated tools. Human and automated methods for identifying accessibility problems complement each other. Human evaluators are more expensive to use but can help researchers identify problems that automated tools generally cannot, such as unclear labeling of links, unnecessarily difficult vocabulary and grammar, inconvenient page layout, distracting visual stimuli, ineffective search capabilities, cumbersome navigation, and privacy concerns. Automated tools, on the other hand, are able to identify some of the most critical problems (e.g., lack of alternative text for graphics) very quickly and at a low cost.

Use Human Evaluators

Have human evaluators go through the Web site. These evaluators should include (a) individuals with disabilities and (b) experts in disability access. ETS has engaged people with disabilities to evaluate the accessibility of its Web pages. An evaluation methodology called "heuristic evaluation" was a useful starting point in our work with human evaluators (Hansen, Forer, & Jacequemin, 1998; Levi & Conrad, 1996; Nielson, 1994).

Use Automated Methods

Use automated tools for validating accessibility. For example, "Bobby" is a software tool that automatically evaluates the accessibility of Web pages. Bobby has features that make it an essential tool for Web developers who want to ensure accessibility of their Web sites.

One can begin using Bobby by going to the site for the Center for Applied Special Technology (CAST), www.cast.org/bobby/. (The name "Bobby" appears to be associated with the site's graphic of a British police officer, commonly known as a bobby.) The user types in the URL of the page that he or she wants to analyze and then clicks the submit button (or simply presses Enter). Usually within half a minute, Bobby analyzes the page and returns a report listing accessibility problems and showing their locations on the page. Bobby is especially effective at identifying problems that hinder the effective use of speech output technology (e.g., "screen readers") by people who are blind or have other language-related disabilities.

A downloadable version of Bobby has some special advantages. It can be used to evaluate accessibility of Web pages that are behind organizational firewalls. One can also analyze many pages at a time rather than one at a time. ETS staff have used this version to analyze thousands of pages (Hansen, 1998).

3. Identify Possible Solutions

Identify possible solutions or elements of a solution to the problems that have been identified. Generally, a workable solution will involve a combination of elements. Depending on the particular set of problems being addressed, each of the following could represent either a solution or, more often, an element of a solution.

Educate and Train Staff

Ensure that staff who work with Web development receive training that acquaints them with the problems faced by individuals with disabilities who are using Web sites. Technical staff can additionally benefit from seeing actual examples of HTML code that address these problems. One source in which to refer is the W3C/WAI "Web Accessibility Content Guidelines" (Chisolm, Vanderheiden, & Jacobs, 1999).

Staff who are members of a Web accessibility project team should receive significant opportunities as well. Some ETS Web Access Project staff have received opportunities to both provide and receive instruction on accessibility issues. They have gained expertise and have shared their knowledge with other ETS staff through talks, presentations, and consultations. Some project team members have also presented material on the subject at national conferences (Hansen, Forer, Jacquemin, 1998; Hansen, Katz, & Forer, 1997; Katz, 1997). Thus, project staff are gaining expertise that will allow them to become resources to the organization and to others.

Make Available Templates and Examples

Make available templates and examples of accessible Web site components. On our ETS Web Access Project Web site, we have accessible versions of Web components, such as practice test questions that provide text descriptions for graphics (e.g., charts, tables, graphs) and that eliminate certain problems caused by use of tables and form buttons. We have implemented one version of an accessible, alternative version of the ETS front door (www.ets.org) and have helped develop templates that will be used in many other pages.

New Technologies

Conduct ongoing investigation into new technologies that may provide important accessibility benefits. Among the most important are HTML 4.0, Cascading Style Sheets (CSS), SMIL, Extensible Markup Language (XML), Synchronized Multimedia Integration Language (SMIL), and Mathematical Markup Language (MathML).

Forge Relationships With Outside Experts

Forge relationships with outside experts and their organizations. Many organizations wishing to improve Web site accessibility will benefit from hiring outside consultants. Members of the Web Access Project worked with a number of outside experts.

4. Select and Implement a Solution

Select and implement a solution that is ambitious yet recognizes limitations of time, expertise, and resources. Develop a strategy for making a significant difference, but realize that not every positive change can take place immediately. For example, certain lower-priority problems may need to go unfixed for a while in order to allow staff to focus on preventing problems in new Web content. Other tradeoffs may involve determining how to take advantage of new technologies while providing adequate support for users of older technologies.

Persistence in the accessibility effort is important. The design, development, and maintenance of Web sites involve many parts of an organization, and change may be slower than desired or expected. Changes to some sites may be frequent, so it is important to check sites frequently for accessibility.

5. Obtain Support for Continuous Improvement

Obtain support for continuous improvement. The following are a few ways to help achieve and maintain continuous improvement.

Share and Celebrate Successes

In a recent article that appeared last year our ETS corporate newsletter ("Project aims at accessible websites"), the Web Access Project team members shared their successes and discussed areas that need improvement. This article has helped raise staff consciousness of the accessibility issue and at the same time credited project staff for their efforts. The team has been discussing ways of publicly recognizing ETS Web sites that achieve a high level of accessibility, and hopes that doing so will help make striving for accessibility something that is motivating and fun rather than a burden.

Conduct Ongoing Training and Education

Conduct ongoing training and education in technology and accessibility issues. We are confident that with Web-related technology and markets changing so rapidly, ETS staff will need to receive ongoing training and education to ensure improving levels of accessibility of Web-based products and services. From time to time, if large-scale changes or improvements are needed, it may be necessary to repeat all five steps of the cycle.

A desirable outcome of such training and education would be for people developing products and services to ask themselves, "How would a user interact with the system if he or she had a visual, hearing, learning, physical, or other disability?" After answering this question, developers would then try to provide alternative media or methods to allow individuals with disabilities to obtain information from a given site.

Involve Individuals With Disabilities

We strongly recommend directly involving individuals with disabilities in all aspects of Web accessibility projects, making them project leaders as well as participants or evaluators. Individuals with disabilities encounter real accessibility problems when using Web sites. While many of the problems are documented, being able to witness the difficulties or to interact directly with individuals who have faced difficulties will add motivation and understanding to your effort.

Maintain a Win-Win Philosophy

Avoid developing an "us versus them" mentality. As we have attempted to facilitate change in the organization, we have tried to avoid placing blame for our current Web accessibility problems. The technologies are new, the standards are new, and we are only beginning to understand how to make Web sites more accessible. We emphasize the fact that we are all in this together, that we are all learning, and that by working together we can make a positive difference in the lives of many people. We take the approach that we will all be winners if our Web sites are accessible. Beyond simply doing the right thing, making Web sites accessible can generate good will and appreciation from customers and also may create a competitive advantage when dealing with the increasing number of clients and potential clients who value accessibility in information products and services.

Develop Consensus to Establish Organizational Policies

Develop consensus among relevant constituencies to establish an organizational Web accessibility policy. This policy should define minimum requirements for accessibility of Web sites. ETS project staff are now working with the corporate Office of Disability Policy and representatives from across the corporation to prepare a corporate Web accessibility policy document. We plan to continue to survey the accessibility of ETS's Web sites periodically with both human and automated raters in order to track our progress and provide feedback to Web developers and others. We believe that, with proper support and learning opportunities, the programs will try to exceed the minimum standards when possible.

Conclusion

A highly effective Web accessibility project will find that elusive balance among research, development, and communication. Conducting research to identify problems using both human evaluators and automated methods such as Bobby has been enormously helpful. Development of accessible Web components and sites (our own accessible Web Access Project intranet site) has been important because it helps demonstrate that we can do what we are saying others ought to do. Communication of findings and results is an important challenge. One ought not work for long periods without presenting results that can be understood and appreciated by individuals outside the project.

Efforts to improve the accessibility of the Web for people with disabilities can make a difference for millions of people throughout the world. Even with the problems that individuals with disabilities encounter with our Web sites, we found that they generally loved the fact that they had ready access to so much information. Our current efforts will help consolidate and extend the benefits that Web users with disabilities have been receiving.

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PEER COLLABORATION and VIRTUAL ENVIRONMENTS: A PRELIMINARY INVESTIGATION of MULTI-PARTICIPANT VIRTUAL REALITY APPLIED in SCIENCE EDUCATION

Randolph L. Jackson (ranjack@u.washington.edu)
University of Washington, College of Education, Box 353600
Seattle, Washington 98195 USA

Wayne Taylor (waynet@eskimo.com)
University of Washington, College of Education, Box 353600
Seattle, Washington 98195 USA

William Winn (billwinn@u.washington.edu)
University of Washington, College of Education, Box 353600
Seattle, Washington 98195 USA

Abstract: In researching educational applications of virtual reality, it is now possible to place several students within a single virtual environment (VE) simultaneously. This raises questions regarding the impact of collaboration within virtual environments on overall learning processes. A preliminary study of 110 sixth and ninth grade students was conducted for the purpose of examining peer collaboration within a VE. Students worked in pairs while investigating the concept of global warming within a fully immersive, 3-D, virtual reality based model of the city of Seattle, Washington, called Global Change World (GCW). It is concluded that most students thoroughly enjoyed and valued their experience with GCW. Continuing research will focus more closely upon the impact of peer collaboration on preconceived or "naive" scientific concepts as well as the possible conceptual change inspired by collaboration within GCW. This preliminary study has successfully demonstrated the potential for GCW to facilitate collaborative learning experiences.

INTRODUCTION

The application of virtual reality (VR) to the educational process is becoming more commonplace, with large numbers of students of all ages experiencing virtual environments (VEs) in educational settings. For example, Youngblut (1998) identifies over forty examples of VR applications that are specifically designed to support learning. These learning experiences can come in many forms, from virtual worlds created via VRML to fully immersive VEs that utilize stereoscopic headmounted display systems. Moreover, with ever-increasing computational processing power, the rapid growth of the World Wide Web, and the ongoing construction of a digital communications infrastructure, the creation of distributed fully immersive, multi-participant VEs running on the Internet are on the technological horizon. Given the growing interest in distance learning and distributed education among educators, it is fair to assume that many fully immersive, multi-participant, educational VEs will come on line as the technology becomes less expensive and more readily available.

Most educational applications of VR are designed to make use of its unique features. These features provide opportunities for students to gain a greater understanding of abstract concepts through the creation of visual metaphors or representations and the ability to scale and manipulate these representations. Working with these representations allows students to investigate relationships between objects in VEs which are unbounded by distance, time, or safety concerns. Designers of educational VEs believe that students retain, master and generalize new knowledge better when given the opportunity to become actively involved in constructing that knowledge through a coherent, firsthand interaction with knowledge domain representations (Winn, 1993).

As it becomes possible to place more than one student within a VE, questions arise regarding the potential impact of collaboration on learning. The purpose of this paper is to report the progress of a proof-of-concept project which is being conducted by members of the University of Washington's College of Education and the Learning Center at the Human Interface Technology Laboratory (HITL) at the University of Washington. Funded by a grant from the UW Royalty Research Fund, this project seeks to investigate the nature of peer collaboration within VEs. We describe an investigation that looked at how easily school children adapted to working together towards the ultimate goal of developing and testing hypotheses regarding environmental factors that affect climate change in a VE designed for use in science education.

BACKGROUND

Arriving at an understanding of exactly how to use immersive VR to support the teaching and learning of abstract concepts continues to be a challenging and elusive goal for researchers of virtual learning environments (VLEs). The potential for VR to benefit education is widely recognized and a number of studies have been conducted that have demonstrated a capability to teach content using VR under certain prescribed conditions (e.g. Byrne, 1996; Dede, 1995; McLellan, 1996; Osberg, 1997; Winn, 1997; Youngblut, 1998). A significant challenge, however, remains in fusing of the affordances of VLEs and educational methods of exploiting them into a demonstrable theory of learning for VR.

Zeltzer (1992) refers to the three attributes of autonomy, presence, and interaction in describing the affordances VR provides. Autonomy refers to the notion that a virtual environment (VE) is to some extent capable of performing its own actions, independent of user intervention. An autonomous VE follows its own path to goals and may or may not change course in response to user actions. Presence is simply the experience the user has of being in a real place when immersed within a VE. Zeltzer claims that for presence to be high, the user must be allowed to interact with the VE both naturally and intuitively; when presence is high the computer interface disappears. Finally, interaction involves the ability of the user to perform actions in the VE according to a logical rationale. Even though the user may have to learn how to function appropriately within the environment, the laws that govern the VE should become apparent over time, allowing for a meaningful interactive experience.

Most educational applications for VR are designed to make use of these and other unique features and affordances. Other affordances include: 1. Allowing students to gain a greater understanding of abstract concepts through the creation of visual metaphors, 2. Allowing students to directly manipulate and scale virtual objects or environments for clearer understandings, and 3. Allowing students to visit places and interact with events that distance, time, or safety concerns would normally prohibit (Winn, 1993, Youngblut, 1998). Designers of VLEs tend to believe that students retain, master and generalize new knowledge better when given the opportunity to become actively involved in constructing that knowledge through a coherent, firsthand interaction with knowledge domain representations.

Much of the appeal for applying VR in education is derived from the observations of educational theorists like Bruner (1986) and Piaget (1929) who have long stressed the value of actualizing learning through making it more real for students. VR technology allows for the creation of a VLEs where students can learn by interacting with virtual objects similar to how they would interact with real objects. Through immersion in a VE, students become a part of the phenomena that surround them. Learning is facilitated through the construction of concepts built from the intuitions that arise out of their direct experience of the environment. More recently, research (Clancey, 1993; Bricken, 1990) has supported the notion that VLEs, by their very nature, increase the human capacity for certain types of learning by allowing users to cross the boundary between third and first person experience, negating the need for a highly abstract symbol system. In traditional education, learning the symbol system of a particular knowledge domain is often a prerequisite to learning its content, as in the case of mathematics or music (Winn, 1993). The problem with this type of learning is that mastery of the symbol system can often be mistaken for mastery of the content, and teaching may end well before students make the link between the two.

First person, or direct, interaction within a VE allows students to construct knowledge out of their own experience without relying on symbol systems. This concept of knowledge construction among learners is more generally referred to as constructivism (Duffy & Jonassen, 1992). Self-constructed knowledge is highly individualized and may represent an improvement over similar knowledge learned by other methods because the learners shape the learning experience themselves. In other words, instead of relying on third-person instructor or text-based accounts of how things occur in the world, students immersed within VLEs can directly experience and interact with the concepts, principles, rules, and procedures found in the domain. VLEs designed from the constructivist approach are seen by some as having great potential for providing powerful learning experiences (Bricken, 1990).

Constructivism has entertained a long history in education and philosophy and is representative of a wide diversity of views that may be summed up in the following points: 1. Learning is an active process of constructing rather than acquiring knowledge, and 2. Instruction is a process of supporting that construction rather than communicating knowledge (Duffy & Cunningham, 1996). While constructivism is seen to imply that there is a tangible world, it argues that it is individuals who impose meaning on that world. Consequently, there can be many meanings or perspectives for any event or concept and the goal of education can no longer be one of instilling an absolute, correct meaning (Duffy & Jonassen, 1992). More importantly, constructivism brings with it the underlying assumption of a learner-centered approach to instruction. Constructivist arguments are often used to defend the design and implementation of VLEs.

Traditionally, most VLEs have placed a single student within the VE. However, as the technology becomes available educators are becoming interested in investigating the potential for collaborative learning in VEs. There has been considerable research on the value of collaborative learning. O'Malley (1995) found that much of the research on collaborative learning has evolved from the works of Piaget (1985) and Vygotsky (1978). Crook (1994), for example, views peer collaboration as having three basic cognitive benefits; articulation, conflict, and co-construction. According to Crook, peer collaboration forces students to make their ideas explicit and public. To do so, they need to learn to clearly articulate their opinions, predictions, and interpretations. Conflict may arise when students disagree in regards to their interpretations. To resolve the conflict engendered by collaboration, they must justify and defend their positions and are thus forced into reflection. Piaget (1985) offered a similar view, noting that socio-cognitive conflict often arises when students holding inadequate or differing views work collaboratively. As these differing views are sorted out, students are forced to reflect upon their own conceptions. Crook's concept of co-construction is based upon Vygotsky's (1978) belief that learning is the sharing of meaning in a social context. Students collaboratively co-construct shared knowledge and understanding by building upon each other's ideas. Given the ability of VLEs to support multi-participant activities, it is easy to see why educators are very interested in examining the potential for using them to support collaborative learning.

GLOBAL CHANGE WORLD

Global Change World (GCW) is a VLE that was designed and programmed by the Learning Center of the Human Interface Technology Lab (HITL) on the University of Washington campus. The GCW environment is created by two networked Hewlett-Packard 9000 workstations running DVISE VR software. Hardware manufactured by Division provides the physical user-interface and consists of an audio/visual rendering system connected to a headmounted display helmet (HMD), a navigation and control wand, and a position tracking system. GCW is capable of supporting peer collaboration by allowing more than one student to be immersed and interactive within the same VE at the same time.

In GCW, student pairs enter a virtual model of Seattle in the current year. They are able to navigate their way around the world using the wand while viewing the world through the stereoscopic HMD. Within the world, the virtual representation of each of the participants appears to the other as a cartoonish pair of large eyes, spiral ears, a triangular-shaped mouth, and a singular cyber hand with which they can manipulate objects. In addition, students are able to speak to and hear each other by means of an intercom system that is built into the HMD. In order to perform tasks within GCW, students access a virtual tool kit that allows them to measure air temperature, amount of greenhouse gasses in parts per million, and yearly rainfall. They are able to adjust such variables as the amount of green plant biomass as symbolized by trees, the number of factories, and the number of automobiles present in the world. After making measurements and adjustments, they can then use a "time portal" to go to a selected year in the future and repeat their measurements in order to determine the impact of their actions on the climate of the future.

In preliminary studies, GCW has been taken to College Place Elementary School in Edmonds, Washington, and Redmond Junior High School in Redmond, Washington where a total of 110 students have participated in collaborative VLE activities. Through these visits we hoped to gather information concerning the educational effectiveness of employing a multi-participant VE as a science education tool. Our subjects were eighteen 11 and 12 year-old boys and girls (9 female, 9 male) from a single sixth-grade class and ninety-two 14 and 15 year-old boys and girls (47 female, 45 male) from three ninth-grade class sections. Differences in navigation and general task performance abilities between the older students and the younger students did not appear to be substantial.

Our first task was simply to familiarize the students with the interface, scientific measuring tasks, and basic nature of GCW. The goal of this first phase of the GCW peer collaboration investigation was to observe and record the student interactions with each other in both world navigation and in performing specific tasks. As noted earlier, the HMDs were fitted with microphones so that the students could speak to each other from within the world. This allowed the students to communicate with each other in their normal voice and appeared to improve communication, facilitate collaboration and enhance feelings of presence. Each student pair spent an average of 20 minutes in GCW.

RESULTS

Upon exiting GCW, students were given a nine-question survey that employed a Likert-type scale. The questionnaire asked them to rate the quality of their experiences within the VE. The results of the survey indicated that the students found the experience to be highly enjoyable and most students said they would like to repeat the experience. About 5% of the students reported malaise (dizziness or disorientation). A few students reported problems with using the wand and seeing clearly in the HMD. Ratings of presence were high for most respondents.

Clearly, the overwhelming majority of students thoroughly enjoyed their experience with GCW and most of the students felt highly immersed within the VE. It was apparent that peer collaboration played a significant role in regards to the level of student engagement within the VE. The ability of the students to speak clearly to each other while in the VE seemed to greatly facilitate peer collaboration. Many pairs of students were highly communicative. As they navigated through the world or performed the requested tasks, they were engaged in near constant conversation regarding where to go, what to do next, and how to do things.

Observation revealed substantial peer collaboration among almost all pairings of students, though some pairs needed initial prompting and encouragement to begin conversing with their partner. Expert/expert pairs of females, who were comfortable with the interface, were the most vocally communicative. Novice/expert and novice/novice pairings of all gender combinations were somewhat less communicative. Expert/expert male pairings appeared to involve more action, such as racing, but still incorporated a significant amount of conversation, as well as the inclusion of vocal "sound-effects" that were related to actions being made, particularly among the younger students.

Male/female expert/expert pairings, as well as male/female expert/novice parings, resulted in what appeared to be a more self-reflective, thinking out loud style of conversation with the experts doing far more talking. These pairs would play hide-and-seek, in the case of experts, or simply try to keep track of each other by talking about what they were seeing. Most groups developed strategies for finding each other by identifying prominent landmarks and agreeing to meet at them. Some individuals picked up and carried large brightly colored objects, such as cars or boats, and waved them around or carried them along with them so the other at a distance could see them.

Though students can fly through the world with their hand controller, many of them were physically active as well. Many students were observed to be pointing at virtual objects with their free hand in the real world while talking to their companion in the virtual world. Several students were quite surprised that they had walked almost halfway across the room when we removed the HMD; they had assumed that they stood fairly still while they were flying around the VE. The students who were the most at ease with the interface were the most animated in their physical movements while immersed within GCW.

A number of students found GCW to be easy to use and made full use of the tools provided. These subjects quickly mastered navigational skills and the use of the environment measuring tools that allowed them to view the VE's current temperature, the amount of greenhouse gases present, and the amount of annual rainfall. While in the world, they were instructed on the use of the wheels controlling the quantity of the VE variables of cars, factories, and biomass. These students flew through the time portal, time and time again, in efforts to determine what the impacts of their changes would be and test theories regarding what changing the variables would do to the environment over time. These students typically rated the experience highly and reported a strong sensation of immersion.

Other students, however, had more difficulty mastering the use of the environmental tool kit and in trying to come up with theories for future environmental outcomes based upon changes made to the variables. Some dyads never got to the point of being comfortable enough with the interface to successfully investigate the environmental research elements of GCW. Those who did often disagreed on the expected outcomes. Time, as well as the scope of this preliminary study, did not allow us to perform a further investigation into the existence or nature of hypothesis generation and testing within GCW. We do know that the students were highly motivated, very willing to work in pairs, interested in exploring virtual space, and capable of performing investigative tasks within GCW. Further research that focuses more closely on the impact of peer collaboration on preconceived or "naive" scientific concepts and the possible conceptual change inspired by collaboration within GCW is planned and data collection will be underway throughout 1999.

CONCLUDING REMARKS

While the potential for VR to facilitate collaborative learning experiences appears to be great, much more research is needed before effective collaborative learning strategies can be developed. It is anticipated that these strategies will vary, depending on the kind of educational experience desired and the learning environment employed. However, for this potential to be realized, designers of hardware, software, and instruction must make sure that it is easy for multiple participants to collaboratively navigate and perform within VEs. This requires improvements of today's input devices including improvements in spatialized audio systems, less cumbersome HMDs, simpler wands, and the eventual introduction of haptic (force feedback) devices. The need for these technical advances is essential, considering that the networking of multi-participant, collaborative virtual environments appears to represent a significant trend for future applications of VR both within and outside of the educational domain.

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Voice Conferencing on the Internet: Creating Richer On-Line Communities for Distance Learning

Markus Kötter
Centre for Modern Languages
The Open University
United Kingdom
E-Mail: m.koetter@open.ac.uk

Craig Rodine
Knowledge Media Institute,
The Open University
United Kingdom
E-Mail: c.r.rodine@open.ac.uk

Lesley Shield
Centre for Modern Languages
The Open University
United Kingdom
E-Mail: l.e.shield@open.ac.uk

Abstract: This paper reports the preliminary findings of an investigation into the use of internet voice technology to support community building for distance language learners. It is asserted that such technology, when chosen in accord with the pedagogical aims of the learning activity designers adds value to the overall learning experience. It empowers and enables such learners, realigns the tutor's role in the direction of co-learner and allows both tutors and learners to participate equally in the learning process.

Introduction

The Open University is the UK's largest modern foreign language learning provider with a current enrolment of approximately 8000 students, all of whom study individually at home, at a distance from each other and their tutors. While the traditional Open University methods of delivery – print, video, audio and face-to-face tutorials - are used by the majority of students, alternative methods of delivery are being actively investigated for those students who require or would prefer them by virtue of their geographical location (they may be in an area which is geographically remote from face-to-face provision) or circumstances (they may be unable to attend face-to-face tutorials because they are, for example, physically disabled in some way, in hospital or in prison). We describe these investigations, outline the learning environments and internet-based tools offered to learners and tutors and examine the outcomes of the initial trials in terms of the features we have found to be necessary to support and maintain an online community of students who are located at a geographical distance from each other.

Background

The research described in this paper comprises part of a larger, long-term project seeking to establish a framework for the use of networking technologies in distance language learning with a particular emphasis on the development of oral – and, as a consequence of this, aural – skills in the target language. During the lifetime of the larger project, technologies from telephone conferencing to voice conferencing on the internet have been employed in order to provide learners with increased opportunities for speaking and listening practice.
Initially, learning activities were designed for use with telephone conferencing systems. These were first

implemented in 1995. Groups of 6-9 students met at weekly intervals in order jointly to use the target language to participate in role-plays or other pre-arranged learning activities and thus to practise their communication skills in tasks requiring collaborative interaction. This framework was subsequently widened to incorporate both telephone conferencing and e-mail to allow students to prepare the broad content of what they were going to say (without writing a script), to refine their positions for the role-plays, and to negotiate with each other in the target foreign language about how to address the fictitious problem which had been posed for the activity.

Results from these trials [Hewer & Kötter forthcoming] suggest that student behaviour is modified according to the tools offered by the learning environment: for example, it was found that learners utilised e-mail to plan and rehearse their oral contributions in a way which was not possible to them when only telephone conferencing without e-mail support was available. Analysis of data collected during the course of that research has also led to the hypothesis that learner performance in the foreign language improves when learners are able to collaborate with each other between scheduled events. For example, students used e-mail to form small groups whose members supported each other in a way that went well beyond what a tutor could offer – in other words, students use such learning environments not only to carry out the required task, but also autonomously to form self-help groups. They employed e-mail for the following purposes: to enhance their knowledge of the vocabulary of a certain speech register and, in order to find out whether other students were able to make sense of their language output, to experiment with various syntactic and lexical forms of the target language that were, as yet, beyond their level of competence (this latter behaviour was also observable in the synchronous oral exchanges). In this environment, learners were able to receive rapid feedback from their peers, and this led to an increased willingness to take risks in the foreign language and so to develop fluency at a much quicker pace than might be expected to result from individual studies carried out in isolation.

A feature which is notably absent from most distance language learning settings is the option for learners to collaborate with each other outside inflexible, scheduled meeting times. While the use of telephone conferencing and e-mail addressed this problem to some extent by encouraging students to exchange e-mail, there was still no affordable way for them to participate in synchronous interactions which were flexible as to time, frequency and the number and composition of participating groups. With the recent increased robustness of Internet audio technology, however, it has now become possible to offer learners this improved access and flexibility, and it was as a result of such technological developments that the current investigations were implemented.

Previous uses of audio applications

A survey of the literature and the contents of listservs concerning the pedagogic uses of Internet-Audio, suggests that research into *on-line* use of audio applications is still very limited. There is streamed radio (via RealAudio) and a small number of homepages from which the visitor can download short audio clips (there are several on-line dictionaries that incorporate the ability to allow learners to listen to the pronunciation of a given entry), one prominent example being Randall Davis' *Randall's ESL Cyber Listening Lab* where it is possible to listen to pre-recorded "chunks" of language. (This site also includes a feature called "Randall's Voice Mailbox" which "gives visitors an opportunity to ask questions via e-mail and then to listen to their responses over the Internet"[Davis 1998b]. In other words, visitors may leave e-mail and then listen to the pre-recorded response to their question once this has been uploaded to the web page.

None of these applications uses audio in a truly interactive form. That is to say, none employs it in a two-way fashion. Streamed audio is very much uni-directional, as is listening to sound files which have to be downloaded from the Internet. The only exception to this seems to lie in a case study reported by Elske Heeren in 1995. This "...was carried out to investigate small-group collaborative learning through real-time"[Heeren 1995]. As a result of this study, Heeren reports that "audio-conferencing plus a shared workspace led to equal task performance as audio-conferencing without such an additional tool"[Heeren 1995]. Even this investigation differs from the research reported here in at least two important ways: firstly, whereas its focus was on assessing the technology's potential to foster decision-making, the current investigation deployed the technology in real language learning activities and secondly, participants in Heeren's investigation were students of philosophy rather than language learners.

In the light of the learner behaviours observed during the activities using telephone conferencing and email then, the current study set out to examine whether the new, Internet-based learning environment would support and encourage not only these behaviours, but also if the increased flexibility it offered would modify learner behaviour still further, encouraging increased collaboration and peer support and thus improving the learning experience as a whole.

The FLUENT[1] project

In the summer of 1998, volunteers from two language courses – first level German and final level French - were asked to participate in a series of training activities, followed by three language learning activities. The entire project lasted from October 1998 until January 1999. Learners were told all these activities, would use Internet audio conferencing software and would give them voice access to each other at any time of day for the cost of a local telephone call, regardless of their geographical location. 30 German students and 26 French students volunteered to take part in the trials after receiving detailed information further to their initial expression of interest. Of these volunteers, thirty students participated in all three activities while approximately three per group dropped out after each of the first two activities.

The learning environment which was developed included not only the audio client, but also e-mail and a website which contained both technical and pedagogical information. Learners were encouraged, both by email and during their audio tutorials, to consult the website to obtain information about how to use the audio client and about the content of each activity. The former information was provided via a Frequently Asked Questions list, whilst the latter was posted to the appropriate webpage on a 'need to know basis'. In effect, students were given information about each activity as and when the tutor believed this to be appropriate. The web-page environment allowed dynamic responses to student requests for further information – whether such requests were technically-based or activity-related.

The Internet audio conferencing software that was used provided very low-bandwidth transport of voice using state-of-the-art encoding. While there are subtle artefacts perceptible to the attentive listener, the voice quality is sufficient for the task of providing students with listening and speaking practice in western European languages. The technology is optimised for relatively low-speed exchange, i.e. using V.34/bis (28.8 or 33.6 kbps) modems. It works with de facto standard sound subsystems; while desktop microphone and speakers can be used, headphones with a powered microphone (widely available at low cost) are recommended. The encoding and decoding algorithms are simple enough to permit the client to work well on mid-range computers (a 100Mhz 32-bit processor with 16Mb of memory is adequate). The server software, which groups users in virtual 'rooms', can run on affordable, mid-range computers – we have been using a desktop 200MHz Pentium machine with 64Mbytes of memory. The server must be able to manage multiple Internet connections, i.e. have an industrial-grade TCP/IP facility (supplied with most operating systems designed for server support). The server for this project was connected to a standard campus Ethernet LAN at 10Mbps.

Students were able to load and configure the software with relative ease. Where difficulties did arise, they could obtain help in the form of telephone and email access to technical specialists on the research team. Those problems which occurred were in two major areas: some students – approximately 15% of the overall total - dropped out of the trials because they could not get the client installed or running on their machines, but the majority experienced few problems. Another area of difficulty concerned latency and reliability of the network connecting students to the server. These connections were provided by a number of commercial ISPs and were not under the research project's control. Thanks to expertise provided by the Open University's Knowledge Media Institute, which has extensive experience in telepresence research and practice, it was possible to inform students of the source and extent of the trouble very rapidly, often as conditions changed "in real time." This ability to reassure students that their own computers were not necessarily at fault helped them to remain confident and engaged, even during temporary "rough patches" due to network conditions. However, these difficulties were exceptional – the vast majority of participants experienced no problems during months of activity.

Findings

[1] Framework for Language Use in Environments embedded in New Technologies

An analysis of preliminary results suggests that the type of audio-support offered to students during the course of these trials is what many distance language learners who are unable to attend face-to-face tutorials and/or who want to learn at their own pace have been looking for. Various participants confirmed that part of what made the project so attractive to them was that they did "not leave home and travel miles for a tutorial", as one student put it. Another major asset was the fact that the servers were constantly available, or, in other words, that students could arrange to meet either on a one-to-one basis *and/or* in group whenever they pleased, thus supplementing the scheduled internet-audio tutorials and occasionally even making them superfluous.

One very important outcome of this study was that it appears that it does not suffice simply to provide the software and to leave the rest to the learner. In fact, the first few weeks of the project required researchers to work long hours to ensure that both the technical and the pedagogical sides of the project were well developed. On the technical side, students reacted in very different ways to the learning environment; for example, one student reported needing to "overcome still high level of nerves" while another reported exactly the opposite, claiming to feel "a little more relaxed than face to face which is good". The project's supporting website had to be maintained and updated on a regular basis and a weekly surgery was provided to offer technical trouble-shooting advice on a one-to-one basis. From the pedagogical point of view, not only did tutors have to develop meaningful, motivating and engaging learning activities, but it was also necessary to lay the foundations to encourage learners to form self-help study groups - that is, to develop as autonomous learners.

A key figure to the success of the whole project was the tutor. The embarrassment several students reported experiencing when they sat alone by their computers, finger on the mouse-button, listening to others' voices from the headset, made it crucial for tutors to provide them with a fairly high degree of encouragement or "back channel cues", such as *uh*, *yeah, really*, etc, or the equivalent in the target language. As the participants' familiarity with the medium grew, they became more confident in using it and their self-consciousness waned. It was crucial, though, to steer them through these initial difficulties and also to allow and encourage them to take their time in composing utterances in the target language rather than to exert pressure on them to speak in order to fill the sometimes lengthy gaps between turns. It is also important to note that, initially, tutors found long pauses difficult to cope with, but, like the students, as they became more familiar with the medium, they adapted their teaching style to provide learners with a learning experience optimally suited to the learning environment.

Yet another essential component of this virtual learning environment is the learning activity. As in 'traditional' learning environments like the real-life classroom, task-design is vital to the success or failure of the experience. It would be wrong to assume that every activity that works in a face-to-face-setting can simply be transferred to a virtual, audio-conferencing environment. The findings of the current research support the hypothesis that "...more explicit structuring of the task content, of the already agreed-on issues, and of the planning and progress was needed to maintain a shared understanding and a shared focus"[Heeren 1995]. Given that the present project is explicitly concerned with language learning, we would like to cite one of our students who, in a different context from Heeren, noted: "The level of concentration required for on-line communication is extremely high and this should enable enhanced focus on the expression of the language as well as enhancing the understanding of the sense of what is being received." This, then, is exactly what we had hoped to achieve – the learning environment allowed learners to concentrate their efforts on using their listening and speaking skills to communicate and interact in the foreign language and thus improving their confidence in the use of the target language.

To summarise, what is asserted here is the following: this project enables and empowers learners to interact with each other via synchronous audio and to form autonomous learning communities whose members are located at a distance from each other. The learning environment changes the role of the tutor to that of facilitator, co-learner and activity co-ordinator and allows learners and tutors to participate equally in the design process. Finally, the technology itself was chosen precisely because it can be used in accord with the pedagogical aims of the activity designers and is thus deployed in a pedagogically- rather than technologically-driven manner - thereby adding value to the overall learning experience.

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Developing Tertiary Courseware through capturing Task Directed Discussions

Mayes, T j.t.mayes@gcal.ac.uk
Department of Learning and Education Development, Glasgow Caledonian University, Cowcaddens Road, Glasgow G4 0BA. United Kingdom.

Dineen, F fgdi@gcal.ac.uk
Centre for Learning and Teaching Innovation, Glasgow Caledonian University, Cowcaddens Road, Glasgow G4 0BA. United Kingdom.

Abstract : The *Vicarious Learner* project is looking broadly at issues concerning the development of a multimedia database system to promote and enhance the role of dialogue in learning. A specific interest, and the origin of the project's name, is in the question of whether and how dialogue can be helpfully "re-used". What benefits can students gain from dialogue as observers, not just as participants? We describe our initial attempts to generate and capture educationally effective discourse exchanges amongst and between students and tutors. Problems encountered with available CMC discourse formats led to our development of a set of Task Directed Discussions (TDDs). A medium sized corpus of discourse exchanges was collected using the TDDs. A selection of two hundred of these TDD exchanges formed the multimedia discourse database to the implemented prototype system, Dissemination. Initial results from a large scale controlled experiment and evaluation of Dissemination are outlined.

The Vicarious Learner Project

Attempts to develop CMC environments that could support appropriate educational discourse has tended to simply result in designers repeatedly making the same mistakes (Graddol, 1989). Motivated by this observation Mayes (1995) has developed the 'Groundhog Day' model of educational courseware in which the roles and interaction between the three types of learning technology are explained; these being referred to as Primary, Secondary and Tertiary Courseware. Primary Courseware is the technology to support the presentation of content, Secondary Courseware the technology that provides the support for the doing of learning tasks and, finally, Tertiary Courseware is the technology that supports learning dialogues, through communication. The present paper looks at how the value of dialogue in learning depends on the structure of the environment in which it takes place. In particular, we consider dialogue which takes place in a "computer-supported communication" (CMC) environment, an approach which is being adopted in many courses from primary schools through postgraduate university courses and continuing education, often uncritically and without fully understanding all the issues which arise from these methods.

Motivated by our own experience in developing web-based CBL environments we describe the reasons for developing a multimedia database of discourse exchanges as a means to promote better discussions (Greeno, Benke, Engle, Lachapelle and Wiebe, 1998). The development of this multimedia system, Dissemination, has been motivated by a wish to exploit technology as a means to promote patterns of discussion and enquiry that have proved difficult or problematic to initiate in traditional educational contexts (Bligh, 1986; Gibbs, 1992). We begin by looking at the Vicarious Learner projects initial attempts to generate good educational discourse and consider the various roles of the environment, the participants and the decisions of the course organisers as some of the determinants of the kind of dialogue that results. These issues underlie dialogue in learning, face-to-face as well as on-line (Newman, Webb and Cochrane, 1995).

Attempts to Encourage Appropriate Pedagogical Discourse

Dialogue is an essential component of learning, particularly in complex, discursive domains. This has been noted by many researchers (Voss, 1996; Laurillard, 1993), but with increasing class sizes and the move toward more and more computer-based courses, this component is ever-decreasing and in danger of disappearing completely. The role of technology must be to push back the threshold imposed by these constraints, this being achieved by opening up new media for discourse that are not subject to the same delivery bottlenecks as traditional methods.

The Vicarious Learner project propose a new type of courseware that aims to support understanding of primary course content (notes, lectures...) by distilling the experience of other learners captured as discourse. Initial attempts to exploit CMC technologies led us to adopt a range of web-based discussion tools, principally the "HyperNews" system (LaLiberte, 1995) -- a tool that manages a collection of HTML pages to provide a forum maintaining persistent discussion threads accessible through a normal Web browser such as Netscape. In the first Computers in Teaching and Learning course (CTL1), this environment was used relatively loosely. Students were prompted by a few seed questions, but then were left to develop the discussion as they chose, with arbitrary but usually quite sparse contributions from the course tutors. Thus HyperNews, as used in CTL1, acted as a form of 'discretionary database' (Connelly and Thorn, 1991), growing and developing only under the motivation of the students themselves.

Based on feedback from the first course and suggestions in the literature on conducting on-line discussions (Sproull and Keisler, 1993), we made the discussions in the second CTL course more structured and participation compulsory. We had tutors post specific questions and participate more, particularly by summarising the main points at the end of each week's discussion.

These changes, which in good 'user-centred' style were based on the comments and observation of real users in a real setting were not successful in improving the discussions. Two effects were particularly striking. On the one hand, all students participated in the discussion in CTL2, whereas in CTL1 only a half of the students made any contribution, though only half of these again (i.e. a quarter of the class) on a regular basis. On the other hand, the number of questions raised in the HyperNews discussion in a given week in CTL1, was typically four times greater than in CTL2. A content analysis of these questions showed those generated in CTL1 to have been 'knowledge-based' questions arising from students' interests and attempts to engage more deeply in the problems underlying the course content (Scardamalia et al., 1992). That is, they were engaging in discussion on the theoretical assumptions and motivations defining the knowledge domain. In contrast, students in CTL2 all participated, but in a generally much more subdued manner, restricting their questions to a more shallow 'text-based' level (Rosenshine and Chapman, 1990).

Turning Discussions into Learning Tasks

In response to our own experience we have developed a series of Task Directed Discussions (TDDs) which encourage students to engage in meaningful structured discussion tasks. The series of tasks gradually demand students to engage in deeper thinking about the domain concepts and 'ease students in' to discussions. These TDDs are a first step both toward developing methods which will be useful for any student population and also toward testing and refining our model of educational dialogues.

In themselves each TDD is a discrete language activity with a set goal, with all discussions being based upon discursive manipulations of a common set of domain concepts. Altogether eleven Task Directed Discussions have been proposed ranging in discursive focus from single concepts to groups of concepts, with varying manipulations of these. Thus, the discussions vary in their coverage of the knowledge domain, the specificity of discussions and the types of epistemic structures that they aim to elicit and make exoteric to others. This is where TDDs have gained a great deal from the lessons learnt in work on second language acquisition, where there is over thirty years of work in using and embedding complex cognitive tasks in structured discussion groups (Skehan, 1998).

For each discussion task the idea is to focus attention on to an explicit and shared set of concepts that have been derived from the Primary Courseware (i.e. the course content). Thus the Primary Courseware remains the target for each discussion task, but the form and scope of each discussion is controlled through specified manipulations of these concepts. So, each discussion form is based around a simple cognitive task and acts as an example of Secondary Courseware. Finally, Tertiary Courseware is produced as an outcome of these TDDs in the form of recorded discussions about the course content. These discussion can then be indexed into a multimedia database to compliment the Primary Courseware. The eleven Task Directed Discussions are :

1. *Amphibolic TDD* : the goal is to examine the multiple interpretations offered by the organisation and Primary Courseware.
2. *Common Denominator TDD* : given a concept, name examples of its application.
3. *Comparison TDD* : describe the connection between two concepts relative to a given criterion.
4. *Defining Terms TDD* : one student attempts describes a concept well enough for another to guess what this concept is.
5. *Depiction TDD* : explore the multiple representational structures, styles or media in which a concept or argument may be depicted (e.g. charts, text, graphs...).
6. *Gestalt TDD* : the explicit goal is to highlight the underlying assumptions made by another student as part of one of their explanations of a concept or argument using a given concept.
7. *Hypothetical TDD* : Encourage learners to reason to and from precepts, conjecturing to and from 'possible worlds.' Examples would be a counterfactual arguments.
8. *Ranking TDD* : rank a given set of concepts in terms of level of importance along a given dimension.
9. *Reconstruct TDD* : have learners re-organise the order and propositional structure of sections of the Primary Courseware to explore the conceptual and functional structure implicit.
10. *Repertory Grid TDD* : select three concepts and describe in what way two are similar, but different from the other one along a common dimension (construct)
11. *Scanning TDD* : select from a designated section of the Primary Courseware a specified number of factors that are the most relevant examples of a given criterion.

TDDs have a number of goals, but foremost is the requirement that through taking part in them learners are implicitly helped in structuring their understanding and developing their knowledge, i.e. that learners are helped in developing their cognitive '*epistemic fluency*' (Morrison and Collins, 1995).

As mentioned above, as a means to explore such issues relating to multimedia indexing and modality presentation of pedagogical discourse we have developed and implemented an indexed multimedia database of these TDDs in the 'Dissemination' tutoring system. A logical representation of the interface structure of Dissemination can be seen in Fig. 1, while an example of the actual system is shown in Fig. 2, below.

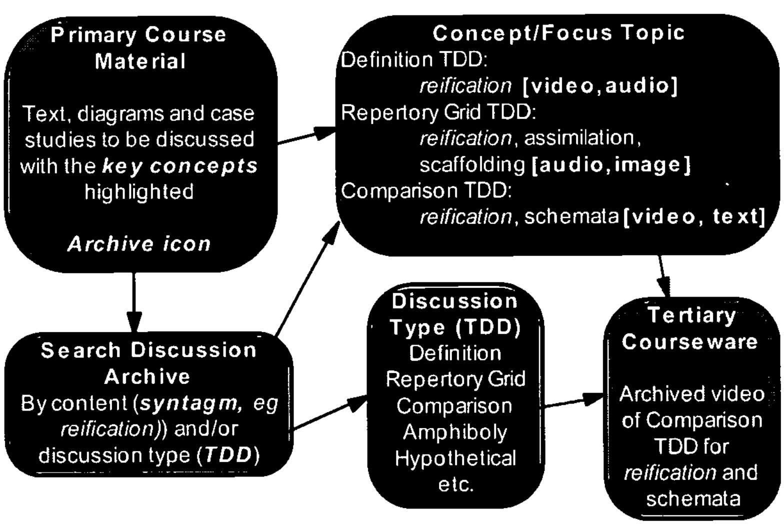

Figure 1 : The 'Dissemination' Tutoring System

Dissemination : An Indexed Multimedia Database of Tertiary Courseware

From a potential resource of over 30 hours of videod discussions Dissemination has been populated with an initial number of 200 media clips as video, audio-graphic, and text transcripts. Further, using Dissemination a large-scale study was undertaken in which 37 subjects were required to undergo a 10 hour learning experiment. The subjects' goal was to learn and understand the Primary Courseware ('The Role of Computers in Teaching and Learning', as in the CTL 1 and 2 courses) well enough to achieve 70% on a test about it (the subjects were told that anyone achieving this score would be awarded a financial bonus). In addition one set a subjects had access to the Tertiary Courseware in Dissemination. However, there was no explicit requirement that these subjects make use of the Tertiary Courseware during the experiment. In fact, given the incentive of the financial bonus it is reasonable to assume - in addition to the subjects own stated comments - that they only made use of this material when they found it useful to do so. As a result we a confident that in using the Tertiary Courseware the subjects were attempting to retrieve those examples of multimedia discourse from the database that would best help them in the interpretation and understanding of the primary course content. Each media clip entered in the system could be retrieved along three orthogonal dimensions :

1. The concept or focus topic of the TDD;
2. The form of the discourse as determined by the discourse goal specified in the TDD;
3. The medium of discourse. This is the dimension along which the discourse is captured and entered into the database (video, audio, text, graphic).

The relationship of the Primary Courseware to the Tertiary Courseware can be seen in Fig. 1. In reading the course notes the learner can access Dissemination through an indexed set of key concepts highlighted directly (top left), or they can access an archived TDD indirectly through a search of the database (bottom left). For each key concept the learner is presented with the indexed set of all TDDs for that key concept in various media (top right). In selecting one of these along the three orthogonal dimensions the learner is shown the desired piece of Tertiary Courseware (bottom right).

QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.

Figure 2 : A Screenshot of the 'Dissemination' Tutoring System, showing the Primary Courseware (centre), the indexed database of TDDs for the concept 'reflection' (top left) and Tertiary Courseware presented as a text transcript (bottom left) and digitised video clip (bottom right)

Tertiary Courseware as a Vicarious Learning Resource

The results from the experiment are extremely rich in data. Giving us information on the cognitive, affective, linguistic and behavioural impact of Tertiary material on learners. At the time of writing we are conducting a series of structured interviews using Repertory Grid techniques on the RepGrid II programme (Gaines and Shaw, 1993). In addition we are analysing the computer logs to look at the media access patterns in relation to the content of the Tertiary and Primary Courseware. Some preliminary data that is of interest in its own right is data showing that there are patterns of preference and individual differences in subjects' retrieval strategies, and that these preferences for Tertiary Courseware develop over time.

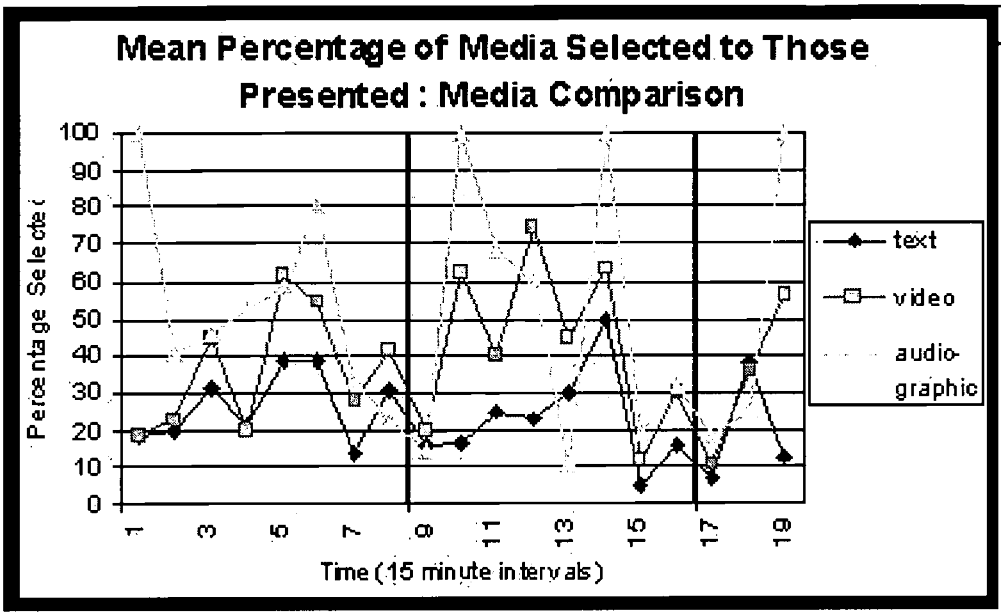

Figure 3: Graph of comparative mean rates of media use for each quarter hour.

The pattern of media use during the course of the experiment can be seen in Fig. 3. Certainly there are a number of surprising patterns suggested by this data. The audio-graphic medium is clearly the preferred medium of retrieval for the Tertiary Courseware. In addition, it was surprising to the experimenters that the textual medium was used at all, as these were verbatim transcription of the conversants' speech (hums and stutters included). One explanation is to understand these results in terms of the 'grounding' of the discourse available in each medium (Clark and Brennan, 1993). Yet the concept of communicational grounding does not adequately explain why subjects would access the same data in different media or would show a preference for one media at one time and another later. This problem is clearly highlighted when one looks at the data on individual differences. For each individual there were marked patterns of preference for one medium over another, though these preferences often changed over time. Additionally, the subjects varied greatly in the volume of material browsed through to the number of clips they viewed or read in their entirety.

Finally, the data on the mean number of clips viewed in their entirety also pose a problem to be explained. Over the course of a single session individuals were less likely to listen or watch a clip in its entirety, the decline being gradual from an mean of 2 per quarter hour to less than 1; with this pattern being repeated during each session. It may be that this is an indication of subjects' improvement in their ability to retrieve the information. Or that their growing understanding of the course notes allowed them to confirm their working hypotheses more quickly. Basically, as your understanding of a subject grows do you simply get better at retrieving the information you need or need to retrieve less information?

Conclusion

In coming to exploit and fully understand the nature and interaction between different courseware media the 'Groundhog Day' model (Mayes, 1995) has proved to be a strong motivating factor in the exploitation of a networked multimedia database of student discussions. In balance of the importance of such learning opportunities in traditional education media (Bransford, Franks, Vye and Sherwood, 1989; Graddol, 1989) it has been important in our work to overcome the technical, psychological and educational difficulties in providing such a resource to learners. Through our early work on promoting discourse we quickly became aware of the need to develop a set of Task Directed Discussions that would guide students in their interactions with the Primary Courseware and with each other. Having produced a corpus of such discussion tasks (some 30 hours) we implemented these as part of a structured on-line database of Tertiary courseware for other learners to exploit.

The large scale experiment conducted using the discourse database (Dissemination) has produced interesting and promising initial results. Using the information from this experiment and from continuing work in developing the multimedia database to exploit the emerging SMIL standard (Synchronised Multimedia

Integration Language) for integrated multimedia frameworks we hope to implement the full Tertiary Courseware corpus. As part of this we are currently subjecting transcripts of the discourse to a range of linguistic measures, for both content and discourse analysis (Gunawardena, Lowe and Anderson, 1998). Such an analysis will be used to further develop the logical database structure of Dissemination for exploitation by researchers interested in the form and properties of pedagogical discourse and CMC environments.

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Evaluating the ARIADNE Core Tools in a Course on Algorithms and Data Structures

E. Duval*, K. Hendrikx, K. Cardinaels, E. Vervaet, R. Van Durm, B. Verhoeven and H. Olivié,
Departement Computerwetenschappen, Katholieke Universiteit Leuven, Belgium.
Erik.Duval@cs.kuleuven.ac.be

Abstract: This paper presents the results of a pedagogic verification experiment we carried out in the ARIADNE project (Forte et al. 1997a; Forte et al. 1997b; Duval 1998; Ariadne 1998). The aim of the experiment was to evaluate the use of the ARIADNE core tools in a course on algorithms and data structures, as it was delivered in 1997-1998 at the K.U.Leuven - Campus Kortrijk. The goals of the evaluation were:

- to investigate the usefulness and usability (i.e. reliability, ease of use, effectiveness and efficiency, etc.) of *the ARIADNE core tools and the ARIADNE methodology for course production and delivery* from the perspective of a *professor* who is responsible for the organization, content and teaching of a university course;
- to investigate the usefulness and usability of an ARIADNE course for *students*, by evaluating the *ARIADNE Learner Interface*. (The content provided through that interface was developed mostly with non-ARIADNE authoring tools).

With this paper, we hope to counter the general observation that formal evaluation of the actual use of technology in education and training is often neglected or even totally absent.

The Evaluation Context

The ARIADNE toolset is quite broad: it encompasses authoring tools, as well as a number of core tools for management and delivery of courses. The experiment reported upon here is concerned with the evaluation of the following core tools and their associated methodologies:

- the *Pedagogical Header Generator*: an indexing tool used to describe educational resources and to enter the descriptions (sometimes called 'metadata') and the resources themselves into the KPS (see below), so that they can be reused in many courses;
- the *Knowledge Pool System* (KPS): a distributed database of reusable multimedia educational components, with circa 10 operational sites throughout Europe at this moment (Cardinaels et al. 1998), that can be queried through the indexing tool already mentioned;
- the *ARIADNE Management Interface* (AMI): a Web interface that enables an author to define a course as a sequence of sessions with associated documents (retrieved from the KPS) and other resources (external web documents, interaction tools like discussion fora or email, etc.)
- the *ARIADNE Learner Interface* (ALI): an automatically generated Web site, based on the course definition created with the AMI (see above), that is used to deliver the educational content to the learner. It provides him with access to the educational material included in the course and guides him through the course in a way predefined by the teacher.

The first three tools were evaluated by the authors themselves, as they were responsible for the course. The latter tool was evaluated by the students who took the course. This experiment is part of a series of ARIADNE pedagogic verification experiments that were carried out by the end of the first phase of the European ARIADNE project (ARIADNE entered its second phase in June 1998).

The Course

The course 'Informatie- en Programma-Structuren' ("Information and Programming Structures") is delivered to 2nd year informatics ('2de Kandidatuur informatica') students at the 'K.U.Leuven Afdeling Kortrijk' (KULAK for short), a *distant campus* of K.U.Leuven, at circa 130 kilometers of Leuven. Professor Erik Duval comes to Kortrijk once a week, where a local assistant is actually based full-time. KULAK students typically take the first two years of their four year program in Kortrijk. Afterwards, they can take the second part of their program in Leuven itself, or in another university.

The *organization* of the course was not so much an ARIADNE related task, but required substantial work during the pre-experiment and the actual experiment phase, because this course was very substantially reorganized, based on the findings of a study committee at our Computer Science Department. Eventually, the course consisted of:

- 23 lecturing sessions of 2 hours each
- 9 guided exercise sessions of 2.5 hours each
- 2 practicals of 20 hours and 50 hours individual student work respectively
- an 0.5 hour oral examination with 2.5 hour preparation time.

The actual *course material* was developed in very close collaboration with prof. Eric Steegmans at K.U.Leuven who was teaching the same course to K.U.Leuven students. In concrete terms, the course content consisted primarily of:

- slides in Microsoft Powerpoint;
- text in Microsoft Word;
- text in LaTex, translated into HTML (manually and/or automatically);
- active existing documents (applets and the like), developed by our team or located with Web search engines, to
- illustrate particularly challenging concepts and algorithms that benefit greatly from visual animations and the like.

This material is structured in an ARIADNE 'curriculum' that defines sessions and the appropriate documents for these sessions. The table below shows a small excerpt of the curriculum for this course. Note that the evolution of the course in time is defined (through the date and duration of the different sessions), so that students can always be guided to the appropriate material at a particular moment in time. An assignment is defined as a so-called 'fuzzy session' that has a start and end date, in between which students must complete the assignment.

...
Session 1: Inleiding
Date: 2/10/97 11:00
Duration: 2:00
Description: Deze sessie handelt over het verloop en de inhoud van de cursus. Tevens wordt kort ingegaan op Java als programmeertaal. Deze sessie komt overeen met p.1-13 in de cursus.
Documents (2):
1.VERLOOP VAN DE CURSUS INFORMATIE- EN PROGRAMMASTRUCTUREN
2.DE PROGRAMMEERTAAL JAVA
...
Assignment: Practicum 2
Start: 12/2/98 15:30 - End: 5/3/98 11:00
Duration: 5:00
Description: Dit is het tweede deel van het practicum.
Documents (1):
1.OPGAVE PRACTICUM 2 INFORMATIE- EN PROGRAMMASTRUCTUREN 1997-98 (KULAK)
...
Session 26: Oefenzitting 8
Date: 19/2/98 15:30
Duration: 2:30
Description: Dit is de tweede oefenzitting rond correctheidsbewijzen.
If-then-else opdrachten
Oproep van procedures, functies, mutatoren en inspectoren
Bewijs van eindigheid
Bewijs van data- en klasse-invarianten
We behandelen ook een uitgebreider voorbeeld: 'het eerste langste plateau'.
Documents (5):

1.If-then-else opdrachten
2.Oproep
3.Bewijs van eindigheid
4.Bewijs van data- en klasse-invarianten
5.Eerste langste plateau

Sample from the ARIADNE curriculum for this course

The Evaluation: Professor Perspective

For the evaluation of the *usefulness and usability of the ARIADNE core tools* from the perspective of a *professor and his team*, the following statements summarize the main findings. These are based on personal experience by the authors as recorded in an interim report:

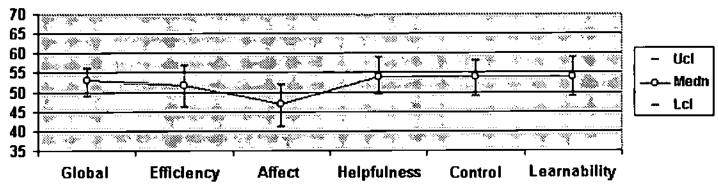
- There is a lot of work involved in organizing a *new* course (or rather: a heavily restructured existing course). This is probably true in general, but the situation was not alleviated through the use of ARIADNE technology. In other words: the *workload of course preparation and elaboration certainly didn't seem to diminish* because of the use of ARIADNE tools
- An important concern was to present and treat the content (algorithms and data structures) in a more *object-oriented* way, with a focus on structured and carefully planned development of solutions, using Java as a programming language. *Few really good examples* exist that treat the content of the course in this way. Even books that promised to offer what we were looking for often used an object-oriented language like Java for the notation, but not the associated object-oriented programming techniques. This resulted in the need for more original work than anticipated, which was only possible through close collaboration with the team that teached the same course in Leuven, as this team has extensive experience in teaching on related topics. *This problem was completely unrelated to the use of ARIADNE tools.*
- Using an ARIADNE *curriculum* to document the actual progress of the course as it takes place actually helps to keep track of the *administration* of the course.
- The ARIADNE Management Interface was *not always robust and easy to use*: updating a course extensively and then not being able to upload the new version is a major source of frustration. (Current developments in the ARIADNE project are tackling this problem.)
- *Adding value* with the ARIADNE approach to a course whose main mode of operation is traditional (face-to-face lecturing with regular practical sessions) *is far from trivial*, the more so in this case where the situation is relatively luxurious in that the students constitute only a relatively small group of 10 where real interactivity with the whole group can actually be achieved.

The Evaluation: Student Perspective

Because of the rather informal nature of the course, with the interactive sessions involving a group of 10 students in a relatively small room, and the very regular contacts between the students and the teaching assistant at Kortrijk, we opted for a *continuous evaluation* through discussions during coffee breaks, email messages, short class discussion during the actual lectures and regular updates with the teaching assistant. Close to the end of the course, a *standardized questionnaire* was handed to the students, with a request to return the filled in questionnaire before the final examination. Five out of ten students did indeed return the questionnaire. Using a commercially available software tool (SUMI), the answers from the students were analyzed statistically, through the kind assistance of SCET, one of the ARIADNE project partners.

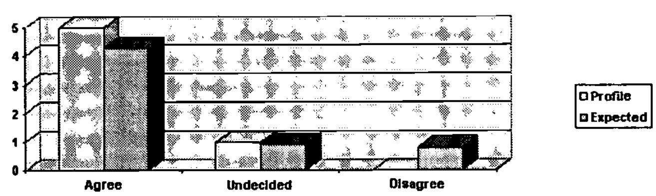
The students were generally quite receptive to the whole idea, although some questioned whether the use of technology didn't make life too easy for the professor, as he no longer had to 'teach' directly, and too hard for the students, as the amount of content could be increased substantially without any immediately apparent organizational problems. It was agreed that the electronic material would be supportive only and that all content would be discussed during the interactive sessions as well.

The figure below represents the overall 'Profile Analysis Graph'. In this graph, the *Global scale and five Usability Subscales* are shown for the ARIADNE Learner Interface, as evaluated by the students. For each scale, the median value is shown circled in the middle of the line; the 95% upper and lower confidence limits are shown by the opening and closing points. These limits indicate the range within which we can be 95% certain that the true scale median for the software can be found. The scales are so arranged that the standard for state of the art software is 50. Software above 50 is ahead of state of the art for quality of use; software below 50 is behind state of the art. Each sub-scale is on a numeric scale from 11 (low usability) to 71 (high usability), with a mean of 50 and a standard deviation of 10.

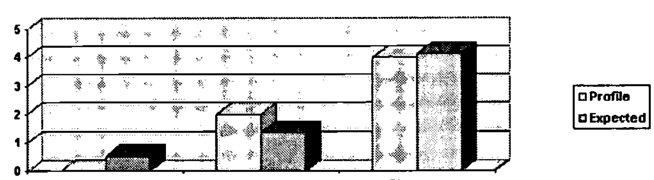


Essentially, the graph above means that students rated the usability of the ARIADNE Learner Interface slightly above 'state of the art'. The main findings of a more detailed analysis of the evaluation results are:

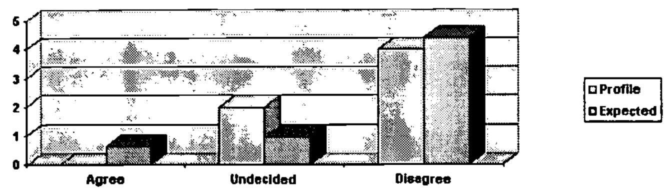
- The overall ARIADNE infrastructure does work *well in field experiments with real students in a real course.* The students do not seem to get the impression that they are treated as guinea pigs for immature technologies.
- The overall ARIADNE *methodology* for course material distribution, based on content in a Knowledge Pool System with structure defined in a separate curriculum and a student web site generated automatically from the combination of these two, is very compatible with a *develop-while-you-deliver* approach to course material production. It should be noted that the latter approach arose from practical requirements and limitations, rather than from an a priori intent. However, this approach is certainly very common and thus the above mentioned compatibility seems quite important for acceptance of the ARIADNE toolset.
- The relatively structured approach to learning, which is typical to ARIADNE, seems to lead, as expected, to purposeful behavior on the students part, as illustrated in the graph below with the reactions to the statement "It is relatively easy to move from one part of a task to another",



and by the graph below with the reactions to "This software seems to disrupt the way I normally like to arrange my work".



- From the standardized questionnaires filled in by the students, one can safely conclude that the ARIADNE Learner Interface is easy to understand and learn working with. Most of the students are by now probably quite accustomed to a World-Wide Web interface with a navigation panel on the left and a content panel that takes up most of the remainder of screen estate. This is illustrated by the graph below, which represents the reactions to the statement "It takes too long to learn the software commands".



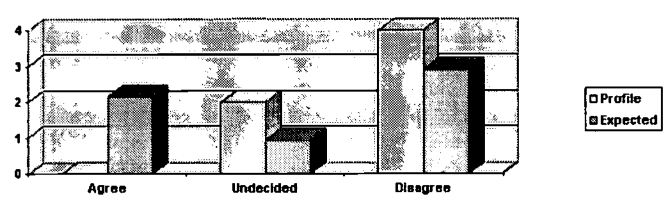
Conclusions

Being responsible for this course, we certainly felt that the ARIADNE toolset and methods helped us to structure the development of this course.

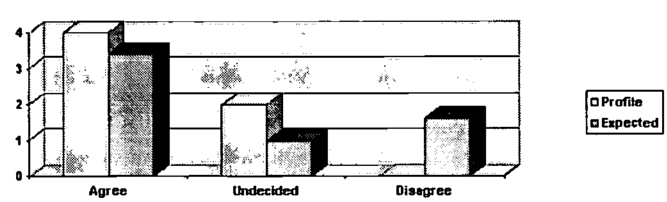
The most crucial remaining problem in our opinion is that it is unclear to see how exactly ARIADNE tools and methodologies can *add value* to a relatively *comfortable traditional situation*, where a small group of students meet almost weekly for 2 hours to discuss the course content, meet every two or three weeks for a 2.5 hours guided practical session and submit the results of their individual work two or three times a year, on which they receive relatively detailed feedback. Of course, this situation is becoming more and more the *exception* and therefor in more general terms the usefulness of the ARIADNE approach seems much more obvious. Remains the question whether developments like ARIADNE do not actually encourage administrations and political responsibles to continue to make the teaching situation more problematic ...

Regarding the evaluation by the students, it should be noted that:

- These were 2nd year students in informatics. One could therefor expect that these students would be somewhat positively prejudiced with respect to the use of telematics for education. This is illustrated by the graph below that lists reactions to the statement "There have been times in using this software when I have felt quite tense".



- The students were explicitly instructed to evaluate the ARIADNE Learner Interface, not the actual content (i.e. the pedagogical documents) provided to them through this interface. It is not clear whether they really were able to make this difference.
- The students were typically working in a LAN environment, with relatively high bandwidth connections on a local ethernet network, as illustrated by the graph below with the answers to the statement "The speed of this software is fast enough".



All in all, it seems that the students were more positive about the usability of the ARIADNE Learner Interface than we had anticipated. It is of course possible that they wanted to 'please' the professor that took their examinations...

Conclusion

In the current academic year, we are reusing much of the content for a new run of this course. This is of course absolutely in line with the 'share and reuse' philosophy that drives the ARIADNE project. We will focus our developments this year on the elaboration of new and the reuse of existing (ARIADNE and non-ARIADNE alike) active components that can really add value to the more conventional course delivery: these components will include simulations, visualizations, self-tests, etc.

More generally, our team is also using the ARIADNE toolset for new courses on computer science topics (first-year programming, Java language, hardware, productivity tools, etc.). Beyond that, the same infrastructure is being adopted by a most active user community that already includes about 40 universities, a number of industrial companies and some consortia of such users. We constantly try to monitor, evaluate and analyze the actual use of the ARIADNE tools in these very diverse circumstances.

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Group Working for Budding Software Developers

Rob Griffiths, Mark Woodman, Hugh Robinson
Computing Department,
The Open University,
Milton Keynes, England MK7 6AA
r.w.griffiths, m.woodman, h.m.robinson@open.ac.uk

Introduction

At Europe's premier distance learning institution, the Open University (OU), we have made computer conferencing central to our flagship computing course, M206 "Computing: An Object-oriented Approach" which began with over 5,000 students in Western Europe in 1998 and which this year is also being studied by 600 students at the Singapore Institute of Management. The course will also become available in North America by the end of the year. The course is primarily concerned with introducing software development and does not recognize the distinction between "computer science" and "software engineering" (see Woodman et al. 1999). It was designed to address the needs of industry and has been given a prestigious IT Award by the British Computer Society. Computer conferencing is central to the course and is used to encourage our students to 'talk' informally about their new discipline, as portrayed in our teaching materials, and also formally to participate in group working projects for which they are graded. At present we are using the FirstClass™ conferencing system[1] for all conference based work – both for the informal talk and the formal group working. FirstClass was chosen because the university has a great deal of experience of it and could commit to supporting our extremely high usage.

The Case for Group Working

People skills are hugely important to the software industry. In contrast to the early decades of software development, its cost and efficiency are now dominated by people issues. Software developers (programmers, designers, analysts) exhibit the normal human characteristics of fallibility and miscommunication. Analysts fail to understand customer requirements or fail to communicate constraints to designers; designers misinterpret specifications or fail to understand technological issues; programmers ignore architectures or skip unit testing. Developing communication skills in students is vital if they are to be useful and, indeed, fulfilled practitioners. Of course, because the language of their discourse is a complex technical one, and an inconsistent one at that, the acquisition and use of vocabulary is itself non-trivial. Another of the problems that neophyte programmers face is that at any stage of their learning their knowledge is incomplete and their skills deficient. From time to time many of them believe that their lack of competence is a permanent state and they fail to realize that what distinguishes professional practitioners is that they have sufficient knowledge and skills to be able to deal with such problems. As well as helping students formulate and organize their knowledge, conferencing encourages students to be reflective, a necessary attribute for collaborative working. The benefits of collaborative working are well established and the practice of it in software development is more or less universal. We summarize the benefits to students of the group working part of their study thus:

- it allows the sharing of information and experience, which allows software development problems to be resolved;
- students can learn from one another;
- group members give support to one another;
- group members often provide motivation to sustain interest and involvement.

[1] FirstClass is a proprietary conferencing system from SoftArc Inc. See http://www.softarc.com

Organization, Problems and Solutions

Students on M206 are assessed by seven assignments that must be submitted by published deadlines coupled with a final exam. The group working element of M206 is composed of four conference-based projects which are associated with questions on three of these assignments. These projects are concerned with concepts students have studied several weeks earlier (the elapsed time for the course is 33 weeks as it represents one sixth of a degree). Hence students should not be overly taxed by the technical content of a project, although in some projects the content is intended to reinforce and extend ideas previously met. Grades for group working are awarded primarily for participation in collective work but there is no dependence on the abilities of other group members for an individual student's grades. That is, there are no collective marks divided among group members, only individual marks. These principles are the core of this part of our pedagogy.

With a course of such a large population size, we have inevitably encountered some problems. Initially we chose to make the size of the project groups between 8 and 10 students. However we were concerned that students should fully commit to a project because failure to fully partake could compromise the ability of other individuals in a small group to earn their grades. This concern about participation was prompted by claims from many students that they did not perceive the need to work with others, despite the OU's unique situation of having a student body whose mean age is 37 and so whose life experience could be expected to motivate this part of the course. Furthermore, we implement a substitution mechanism for the assignments whereby the least scoring assignment is substituted with the average mark from all other assignments. Therefore, due to the distribution of project work amongst the assignments, students can pass the course (albeit poorly) without participating in group working. So, to encourage participation and to maintain the viability of the individual groups, for the 1998 presentation, students could only take part in a group working project by registering for the project by a registration cut-off date. Students used FirstClass to send a proforma, pre-addressed project registration email to the M206 Group Working server. This server (which we developed in-house) collated and acknowledged (via FirstClass) the receipt of all registrations and, when registration had closed, randomly assigned students to project groups and hence to conferences. This involved the creation of about 800 separate conferences. The server then emailed each student the address of their project conference. However, despite email reminders and notices on both our Web site and the conferencing system, some students still failed to register for projects by the registration cut-off dates. This was generally due to two reasons: either they were unable to access the registration mechanism during the registration period (one student was under the polar ice cap in a submarine!) or students assumed that enrollment to the course equated to registration to all projects. Therefore for 1999, we decided to make project groups significantly larger (typically 25 rather than 10) and to automatically register all students for all projects. Due to the larger group size, student drop out from project participation should not significantly effect the viability of a group. At the time of writing the 1999 students cohort have not yet reached this stage of the course.

All the projects have multiple stages, with each stage being associated with a hard deadline. This can be seen in Fig. 1 which shows part of our web-based group working calendar. As various stage deadlines approach, the server sends out automatic reminders of the forthcoming deadline.

Project Schedule

Study Week	Project I Dates	TMA	Due Date
9	Stage 1 starts 10-Apr		
10	**Stage 1**		
11	Stage 1 ends 27-Apr Stage 2 starts 28-Apr		
12	**Stage 2**		
13	Stage 2 ends 11-May		
14		TMA03	18-May

Figure 1: Calendar for Group Working Projects

Typically, in the first stage of a project a student must study some new problem or variation on a familiar one and carry our some task such as writing a critique of a user interface, coding a subclass in Smalltalk or addressing issues to do with the analysis and design of some problem area. Subsequent stages usually involve commenting on, or testing other students submissions and/or going deeper into the problem.

Collaboration on a project is only deemed to take place if it has happened in the computer conference generated for that purpose. This is crucial for allowing graders to check that project work submitted in an assignment actually took place in a collaborative manner. However, this strategy has thrown up challenges. In particular we had to prevent the situation in which a talented student gives a complete answer so preventing others from making an effective contribution. To combat this, for Projects I and II, the project conference is not made visible on the student's FirstClass desktop until after the Stage 1 deadline. This means that whilst students can use the supplied conference address to post their Stage 1 contributions, they cannot see fellow students postings until after that deadline, thus solving the preemptive contribution problem mentioned above. After the Stage 1 deadline for Projects I and II has passed, for each student, the server makes their project conference visible on their FirstClass desktop.

A final issue encountered in 1998 was that of coordination of project participation which was related to the time period allotted for each project (about 4 weeks – see Fig. 1). Because of the varied lifestyles and domestic demands of the several thousand students in the "class", they inevitably tended to want to work at their own pace within the given time frames for the various stages. Some students would start work as early as possible, posting their ideas as to how to approach the posed problem only to be frustrated by having to wait up to two weeks for any feedback, as other members of the group were delaying their work until the latter half of the available time frame. We expect that our decision to enlarge the group conferences described above will also overcome this problem.

Sample Content

In the 1998 presentation of the course, Project I involved critiquing a user interface and consisted of two stages. Before they started this project, students had an opportunity to examine a sample project on the same topic and see how another group of students had tackled it. This sample project consisted of a software application and examples of conference postings that the group had made for each of the two stages. As in the sample project, stage 1 of Project I, involved students in having to analyze and write a critique of a supplied application's user interface, paying particular attention to the principles of visibility, affordance and feedback (principles to which they were introduced early in the course). This critique was then sent to the Project I conference by the deadline for Stage 1. As described above, these Stage 1 postings were not visible until after the stage's deadline had passed. When these postings became visible, Stage 2 involved students making some constructive comments about another group member's critique of the same user interface. This form of group working is of course highly constrained and somewhat artificial. However we deemed this to be necessary, in the first instance, to introduce our students to the notion of group working in a managed fashion. By comparison, the final two projects are much more realistic: students work together to solve a common problem. The group conferences are visible from the start and the interaction is much more fluid and discursive, with students making multiple postings for each stage.

Conclusion

Educational institutions often treat students as individuals who will produce independent pieces of work, and during their education are not often encouraged to share ideas, work together or evaluate each others work so that it can be improved. In the work place the opposite is expected. This is especially true in the software industry. Software developers are expected to work together, be team players, share ideas, and work towards common goals. Increasingly employers want evidence of such skills and aptitudes, which often require some degree of work experience before they can be mastered. Furthermore group working helps the budding software developer to think in terms of complex systems rather than just their part of that system or of traditional simple programs. To meet these industry requirements we have developed a suitable pedagogy and the mechanisms by which students can work collaboratively on projects over extended periods of time.

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Organizing On-line Resources between Web and Computer-based Conferencing

Rob Griffiths, Barbara Poniatowska, Mike Richards, Hugh Robinson, Mark Woodman
Computing Department,
The Open University,
Milton Keynes, England MK7 6AA
r.w.griffiths, b.m.poniatowska, m.richards, h.m.robinson, m.woodman@open.ac.uk

Introduction

At the start of 1998 Europe's premier distance learning institution, the Open University (OU), deployed a new introductory computing course, M206 "Computing: An Object-oriented Approach" (see Woodman et al. 1998). The course counts for one sixth of a degree (440 hours of study) and represents a radical change to the computing curriculum and a radical change to how supported distance learning courses are presented. Reception of the course was unprecedented, with over 5,000 students registering and its innovations being recognized by a prestigious IT Award from the British Computer Society. Now in its second year, some 600 additional students at the Singapore Institute of Management are taking the course, and with the OU now incorporated in the USA, it should be available in North America by late 1999. The course has a full mix of media: paper, broadcast television, interactive CD-ROM, a Web-oriented programming and learning environment, a Web site and computer-based conferencing. From the start of work on M206, we committed to a Web-centric strategy: "home is where the Web is" became the course team chair's slogan! In other words we wanted to organize all learning resources around the Web (see Sumner & Taylor 1998). Ideally we would like to have all such resources accessible via a common front end – a Web browser. However, pragmatics intervened, as described below, and we have not yet achieved our ideal. In subsequent sections we explain our technology architecture and the problems we experienced, together with consequent changes we had to implement for the 1999 presentation.

The Web Site as a Repository

We believe that the Web should be the seamless mechanism for all electronic communication: email, conferencing, Web pages, downloads, and whatever. For pragmatic operational reasons we had to compromise this ideal in order to provide students with a robust conferencing system that was fully supported by the OU. Hence, electronic communication became split between the M206 Web site and the FirstClass™ conferencing system[1]. Faced with this split we needed a clear principle for deciding what would be available via FirstClass and what would be available via the Web. Such a principle was not immediately obvious, since FirstClass could adequately support more than just conferencing – for example, a read-only notice board could disseminate new information and offer downloads and, with its use of an off-line reader, was arguably less expensive for our students to use in terms of connection time. The principle we arrived at is enshrined in the slogan, "FirstClass announces; the Web pronounces." That is, the Web became the repository for all non-transient learning material (errata and addenda to learning materials, assignments and mock exams, software downloads, etc.). Whenever any new learning material was added to the Web, the fact of the addition was announced on the student FirstClass Notice Board, directing the students to the appropriate Web page by means of a logical reference, for example, "Details of the revised Practical 9 are now available on the Chapter 15 Web page").

The 1998 M206 site was designed very much as a compromise between what was possible and what was acceptable. The main constraints on our site were those relating to the computers and communications used by our

[1] FirstClass is a proprietary conferencing system from SoftArc Inc. See http://www.softarc.com

students. The minimum computer specification precluded the use of graphically intense designs and greatly limited the amount of "bells and whistles" that could be included. In addition there would be a limited amount of staff time available to develop and maintain the site. The 1998 site was therefore designed in HTML 3 using a conventional frame-based solution. Navigation was handled by means of a frame on the left-hand side of the screen, with the contents of pages appearing in the right-hand frame (see Fig. 1). The design of buttons was chosen to reflect those used in other interactive course materials.

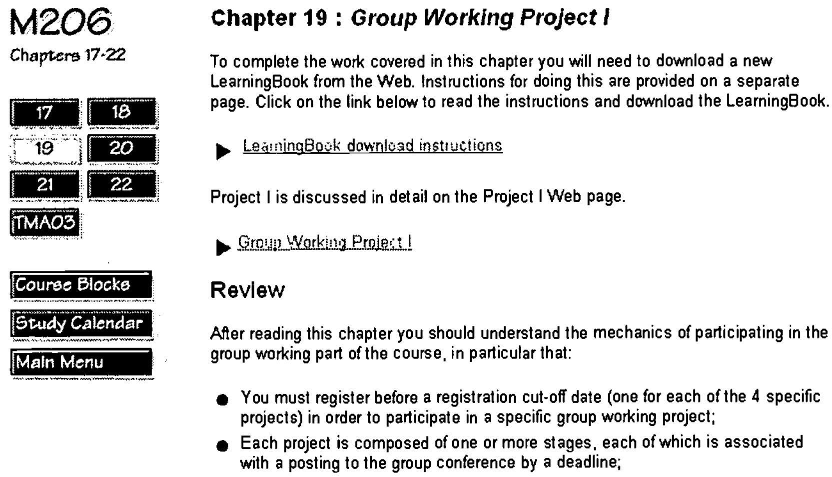

Figure 1: M206 Web site

The site was sub-divided into a number of areas relating to different aspects of the course, including information about using the site, calendars, etc. The main resources sections were:

Course Blocks – the course is broken into seven "blocks" each one covering a number of "chapters" (any multimedia unit) with an associated assignment. Chapter Web pages comprised of a recap of the important points and a section detailing any misprints or omissions. These pages also provided additional learning material, such as background reading, or transcripts of television programs.

Assessment – this section contained pages for the seven assignments and a specimen exam paper. On each page there were links to downloadable copies of the documents.

Software – students could use this section to update, download or test their software. Links were provided to software vendors and full installation guides given for the software.

Contacts – students must deal with a number of different parts of a large organization like the OU whilst studying. The contacts page listed the types of problem students might encounter (such as the failure of a password or missing course materials) alongside the appropriate postal or email address or contact phone number. As well as making the contact procedure less problematic for the student, it reduced the amount of mis-addressed email and post for the university.

News – originally all course news was distributed by means of the FirstClass system (see below), however, it was later decided that the Web offered a more robust solution to all of our users and the two systems were used in parallel. Items relating to the course (such as the posting of new pages, corrections to materials or notices about computer downtime) were posted on this page; old items were archived on linked pages for reference.

Conferencing as a Community

Of course, electronic conferencing was used for much more than notice board style announcements. Conferencing underpinned the support for group working that is an important part of M206 as well as providing an electronic forum for students to discuss all matters of interest to them in relation to the course. In our first year (1998), we created a detailed national conference/sub-conference structure based around the structure of the course (fifty two chapters organized into seven blocks, essentially). This conference structure was available to all 5,000 students.

We used FirstClass in several ways: first as the primary means of communication between the central academic team and both the student body and the part-time tutors supporting them. For example the M206 Notice Board conference was used for our "pronouncements". FirstClass was also the most direct way students had to communicate with us via an email id called M206 Course Office – a front for administrators and academics. We also used it for informal discussion of the course materials and, crucially, collaborative group working (see Griffiths et al. 1999).

Ease of asynchronous electronic communication immediately created a very real sense of a community of learners and teachers, interacting with the material and with each other's ideas and views. As teachers, we felt we had to be part of that community, reacting to requests, clarifying issues and (occasionally) defending ourselves against suggestions about the elegance, clarity and relevance of some of our teaching. Such involvement made huge demands on the academic's time, with the course manager and an academic often devoting 50% of their time to queries. The locus of control of the course was no longer firmly teacher-centered and the nature of the relationship teacher and taught was irrevocably changed.
There was a strong tendency for this community to be one that was sharing "bad news" or telling "war stories" – from inability to read some file, to ambiguity in an assignment question, and on to downright errors in learning material. This could actively construct a perception of a troubled course when the reality was quite different. Fortunately, there were various episodes where hundreds (if not thousands) of students actively emailed their general (and often enthusiastic) appreciation of the course. This did much for the frayed morale of teaching staff!

Problems Leading to Reorganization

Whilst the first year of presentation was successful, it was not without its problems. Students began to voice frustration at having to go to FirstClass to find a news announcement and then having to go to the Web for the detailed pronouncement. Furthermore we broke our own principle of "FirstClass announces; the Web pronounces." when it came to dealing with clarifications and tips and hints on assessment material – for both urgency and ease of student use, we made these pronouncements available via FirstClass on the M206 Notice Board. To avoid this confusion, for the 1999 presentation we have moved the M206 Notice Board to our Web site. The Web is now the sole site for both news announcements and pronouncements whereas FirstClass is solely used for conferencing.

Another problem that manifested itself with the 1998 presentation was that our use of national conferences placed an unacceptable burden on the central academic team and there was evidence that whilst it provided a vehicle for articulate and competent students it did not always support students in difficulty. Our use of national conferences also ignored an important resource – the 250 tutors who are employed part-time to assess student assignments and offer face-to-face tutorials and other support to groups of (typically) twenty to thirty allocated students. We have therefore adopted a somewhat different conferencing approach for the 1999 presentation. Instead of large national conferences each tutor now manages a tutor-group conference for their allocated students. The tutor-group conference is a vehicle for (a smaller, more focused and supportive) discussion of the course and associated issues throughout the year, as well as being the basis for sub-conferences to support group working. This will undoubtedly construct a different learning experience for both us and our students. Gone will be the wild roller-coaster ride of an electronic community of 5,000 students and teachers discussing every aspect of the course. In its place we aspire to a more localized and supportive structure of small groups, centered around a tutor and her/his students.

Conclusion

A pragmatic organizational requirement to use a proprietary conferencing system as opposed to a Web-based system led to a split in our computer-based resources we would rather have avoided. Consequently we had to establish a clear principle for dividing material between two "places" students would see as distinct, something that would be reinforced by the very different user interfaces. We initially determined that the FirstClass conferencing system would "announce", whereas the Web site would "pronounce". This supported the metaphor that FirstClass was a place to meet for talk, both informally and (in group working) formally and that the Web was a repository of useful, indeed vital information. However this split proved unacceptable, as it forced students to access two resources in order to find important course information. Hence for the 1999 presentation FirstClass is being used strictly for conferencing and the Web for both student notices and static, more considered information.

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Hypermedia and Telecommunications
Are Only Good If You Can Use Them

Lois Hendrickson
Wang Global, Wang Government Services, U.S.A.
E-mail lhendri2@gmu.edu

Abstract: In education, our desired arena of presentation has moved from the immediate environment to the world, but we have not been able to make the necessary paradigm shift in the way we think about design and accessibility to allow the world to join in. Projects are typically dictated by the *content*, the *audience*, and *available space*. Using the Internet and Intranet has altered some of these limitations but the main concern is still the content. It requires that we look more carefully at how to organize and present the content. Concerns of how to display a project have moved from a concern of space availability to concerns of usability and accessibility.

Your web pages cannot be all things to all people. They can be accessible to and usable by the largest audience possible. This paper looks at some easy-to-implement ways to do this.

They Are Only Good If They Can Be Used

Multimedia/hypermedia and telecommunications activities are only good if they can be used. That, obviously, is common sense. Why even bother stating it?

Why? Because in many instances we design these activities to keep potential learners at a distance. Not deliberately, of course, but we still do it, especially in web-based instruction. In education, our desired arena of presentation has moved from the immediate environment to the world, but we have not been able to make the necessary paradigm shift in the way we think about design and accessibility to allow the world to join in. Projects are typically dictated by the *content* (that which is to be taught) the *audience* (those who are to be taught), and *available space* (the size of model or poster board that can be carried to school or the amount of shelf or wall space available in the classroom). Using the Internet and Intranet has altered some of these dictates but the main concern is still the content.

Use of the Internet or Intranet requires that we look more carefully at how to organize the content into meaningful chunks that can be presented in a clear, concise manner on web pages that are robust enough to stand alone, yet are small enough to be downloaded easily. The target audience is no longer simply the class, the school, and the parents. It is now anyone, anywhere with an interest in the school, the students, or the content of the web page. Concerns of how to display a project have moved from a concern of space availability to concerns of usability, accessibility, and intuitiveness.

Your web pages cannot be all things to all people. They can be accessible to and usable by the largest audience possible. This paper looks at some easy-to-implement ways to do this.

The Audience

Knowing that your audience can be anyone—of any age —with any interest is not helpful in the analysis process. You have to decide who your main audience will be and work from there. If you're involved with a school, you can assume the school's administrators, teachers and students will be part of your audience. Students in other schools, relatives, friends, former students, and anyone with an interest in the use of technology in educational settings will also be interested in your pages.

Your audience, and here we are talking only about the people who actively seek you out, will include those with the fastest modems and latest computers to those with old systems, slow modems, and monochrome monitors. It will also include the deaf, the hard of hearing, those who are blind or have limited vision, individuals with physical disabilities, and users who feel challenged by technology. They are individuals who may have problems discerning colors in graphics and text or those who have turned off the graphics function on their computer or those who use a screen reader. Unless an alternative method of delivery is available, content presented only via audio may be lost to individuals with hearing impairments or those without soundcards in their machines. Pages with closely spaced hyperlinks can create navigational problems for individuals with certain physical disabilities. Context that is not easy to understand, distracting graphics, or noisy backgrounds make pages less accessible or less usable for most users.

Web pages that do not meet the needs of the user will suffer the fate of either the "Back" or the "Stop" button. Without that audience, there is no reason for your web pages to exist. The information could be presented just as effectively face-to-face in a classroom.

What Is There And How We Get To It

Focus On Content

We build web pages to convey content. If there is no content, there is nothing to convey. Pages that are simply lists of links to other sites are useless if those sites are down. The links you put on a page should be additional resources to give more value to what is presented on your page, not the primary reason for the page's existence.

Unlike printed pages, pages on the web must be designed to stand alone. A user can enter at any page using any browser. Just as you would want a guest in your home to feel as comfortable as possible, a guest at your web site should also feel comfortable. Upon entering any page, the users should know where they are, what else is available to them, and how to navigate from one page to another.

Provide Relevant, Reliable Links

- Check your links frequently. A page filled with "dead" links is frustrating.
- Provide a visible link at the top of each page to allow users to move back and forth between the graphical and alternate versions of the page.
- Have the text only version of the page link to other text only versions. Otherwise, for every page the user is linked backed to a graphic version, only to have to link back to the text version.
- Place non-link printable characters (surrounded by spaces) between links that occur consecutively, e.g., the use of "|" between the links at the top and bottom of this page.
- Screen reader users often read the page, then tab through the page moving from one link to another. Since they are tabbing past the surrounding text, landing only on the links, a link may be meaningless. Create meaningful link phrases. The phrase "full text of document" is more meaningful than "click here".
- One way to make the links stand out clearly for the screen reader user is to make the links separate from the body of the text, e.g., in a list or a menu following the text.

Provide Alternatives

Providing alternatives makes your site accessible to the largest number of people possible. This means, among other things, providing alternative versions that convey the same message as the graphics or audio.

A page does not have to be dull and boring to be equitable. It just needs to present alternatives.

- Give users the ability to use the browser of their choice and not to be forced to use the one for which your page was designed.

- Use the "alt" attribute to provide alternated text for images, e.g., <IMG SRC="dod.gif" alt="Department of Defense Logo"> . In using the "alt" attribute, keep the text short. It might be easier to describe the function of the graphic rather than the graphic itself.
- A D-link is a link to a long text only description for graphics, such as tables, charts, or diagrams, which have important information. Example: <IMG SRC="enrollment.gif" alt="Chart of school enrollment 1998><A HREF="enrollment98.html">D</A> The "D" would appear next to the graphic of the enrollment chart. When the user clicks on the "D," a text only description of the chart will open.
- If possible DO NOT use frames. If you do use frames, provide an alternative text version.
- Provide a text transcript for all information presented in auditory form.
- Provide an auditory alternative for all information presented in video form.
- Provide a text transcript for all information presented in video form.
- Provide text summaries of tables for non-visual users.
- Provide both graphic and text versions of web pages.
- Users should be able to determine the colors for backgrounds and text as well as the size of font used. They should be able to work in an environment that is comfortable for them.
- Include a note about accessibility. Encourage users to notify you with concerns about accessibility or usability.

Make the page clear, concise, intuitive, and consistent

In your classroom doors look like doors and the doorknob is where you would normally expect it to be, not on the ceiling. Elements on your web page should also look and act the way you would expect them to do. Selecting the blue, underlined text Contents should take you the Contents page, not start a movie about the migration of ants.

-
- Be consistent. Page elements that perform the same function on different pages should be located in a constant location on every page. Pages that are consistent in layout are easier to navigate and easier to maintain.
- Users should be able to determine the colors for background and text was well as the size of font used. They should be able to work in an environment that is comfortable for them.
- Use an internationally understood date format: January 9, 2002, not 01/09/02.
- Make sure there is clear contrast between the text and the background.
- The background should be just that – a background. Don't let it be more interesting and attention-getting than the content.
- Test your page by running it in monochrome mode.
- Provide a visible link at the top of each page to allow a user to move back and forth between the graphical and alternate versions of the page.
- Test your pages with a variety of web browsers.
- Keep it simple.

HTML is not a desktop publisher

HTML not a desktop publishing environment. It is a content markup language. Web authors prepare and present content. They use HTML to structure paragraphs, headings, lists, and tables. It is the users who can configure their browsers to choose font size and color. When building web pages, start with the content and then add the necessary, relevant the links and images. Don't use HTML to create a page that cannot be reconfigured by the users to meet their needs. Use it to create pages that are proportionally structured so users are able to change font size and color.

- Use style sheets to control layout, alignment and positioning.
- Use standard HTML. Do not use functions that will work only on specific browsers, e.g., <Blink> is not supported by all browsers.
- Marquee text is often read one word at a time as it appears on the screen. It may be read backward one word at a time if that is how it appears.

- Use logical rather than physical markups: for italics use the logical <EM> instead of the physical <I>. For bold text use the logical <STRONG> instead of the physical <B>.
- Provide a single downloadable file for documents that appear on separate pages.

The Display

Keep the pages small, no longer than a screen-and-a-half in length. The total page size, including graphics, should be about 30K, 40K is pushing it. It should take no more than 10 seconds to download a page. Keeping it small means it is usable even on old systems with slow monitors.

- Do not use frames.
- Keep page layout simple and straightforward.
- Use text that is clear, concise, and easy to understand.
- Keep the backgrounds simple. Users, especially those with low vision, colorblindness, or a monochrome monitor may have trouble reading text on busy backgrounds.
- Leave ample space around items to be selected.
- Avoid large graphics taking a long time to download. Usually a smaller version will do. Provide a link to the larger version.

Tables

Tables may be difficult for screen readers to read. If tables must be used, provide a text only version of the table.

Try this to see how a table might be read by a screen reader:

1. Open a web page that has a table.
2. Hold a piece of paper up to the screen so it can read only one line at a time.
3. Read the line aloud. Does it make sense?

For example:

Distance Learning	Traditional Classroom
allows asynchronous	allows teachers to grasp
interaction — not the	teachable moment.
dependent on time	
or place.	

With a screen reader, this might be read as:

Distance Learning Traditional Classroom allows asynchronous allows teachers to grasp interaction — not the teachable moment. dependent on time or place.

Lists

Lists can also be confusing for non-visual users. A list that is several layers deep may be easy to follow visually; however, if it lacks discernable clues to indicate the layers the non-visual user will be unable to read it easily. Additionally, if text wraps to the next line it may appear as two separate entries.

The list:

- School Supplies
  - Paper
    - Lined
    - Graph
    - Sticky pad
  - Pencils
    - Black #2 lead
    - Red for marking
  - Pens
    - For writing

Black ink
Blue ink
For marking
Yellow highlighter
Blue highlighter

Might be read like this by a screen reader:
School Supplies
Paper
Lined
Graph
Sticky pad
Pencils
Black #2 lead
Red for marking
Pens
For writing
Black ink
Blue ink
For marking
Yellow highlighter
Blue highlighter

Use formatting options, such as numbering conventions, such as compound numbering to understand.

School Supplies
1. Paper
   1.1. Lined
   1.2. Graph
2. Pencils
   2.1. Black #2 lead
   2.2. Red for marking
3. Pens
   3.1. For writing
      3.1.1 Black ink
      3.1.3 Blue ink
   3.2. For marking
      3.2.1. Yellow highlighter

Eight easy tips

1. Provide text summaries of tables for non-visual users.
2. Avoid using tables if possible.
3. Avoid using tables as a way to control layout, such as putting text in columns.
4. If you are using a table to layout text and numbers the screen reader may append all of the numbers from the different columns in the same row into one number. Provide a text only version if you want to use the table.
5. Using numbered (ordered) lists makes it easier for those using screen readers to keep track of where they are in the list.
6. State the number of elements in the list.
7. Provide text summaries of tables for non-visual users.
8. Test your table.

Being aware of the need to make web pages more accessible and usable is the first step. The next step is to incorporate accessibility and usability design features into your web based instruction. Using the design suggestions mentioned in this paper will not make your web-based materials accessible to everyone. Their usage will, however, help you get started. Designing accessible and usable web pages may require a learning curve but, like all good things, it is well worth the effort. To help you, there are many excellent resources on the Internet to help you in designing accessible and usable web pages. The World Wide Web Consortium (W3C) at http://www.w3.org, one of leaders in this area, even provides an HTML validation service to test your pages.

Remember, your multimedia/hypermedia and telecommunications activities are only good if they can be used.

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Concept Tagging and Dynamic HTML Generation for Adaptive Teachware

THOMAS T. FUHRMANN

Praktische Informatik IV
University of Mannheim
Germany
fuhrmann@informatik.uni-mannheim.de

Abstract: Static HTML links are not appropriate for quickly evolving teachware to which several authors independently contribute material on overlapping topics. Furthermore static links are not capable of providing students with an individualized linearization of the hypertext suited to their individual level of previous knowledge and competence. We hence propose a linking mechanism based on concept maps and a respective tagging of the source material for the course. These tags are used to dynamically generate HTML pages that reflect the learning level of the individual students.

1. Introduction

The ability to use mathematical language is one of the most important ingredients for a successful study of natural sciences and engineering. It is also one of the subjects feared most by students since training in its abstract way of thinking is not thoroughly practiced at school. Hence a dislike of mathematics or the self-perceived failure to understand its concepts is one of the most frequent reasons for not choosing technical subjects.

The Faculty of Physics at the University of Heidelberg is thus trying to smoothen the entry into the abstract world of physics by offering a two-week tutorial course in mathematics for first year undergraduates. During this intensive course the students can revise and practice their skills in central areas of mathematics like calculus, complex numbers, vectors, and matrices that are required in physics almost from the first day on. Especially students who are not fresh out of school but who have completed their military service or an apprenticeship prior to their studies show a great need for intensive recapitulation of mathematics.

Since the mathematical knowledge of first year undergraduates differs vastly from student to student a personal tutor for each would be highly desirable though of course not affordable. Therefore, two years ago we began experimenting with various electronically enhanced means for undergraduate mathematics education that can do more than the usual multimedia-enhanced teachware.

Two specific challenges characterize our project. Firstly, many authors with different objectives contribute on a continuous basis to our courseware even though it is already being employed. Secondly, the students using the courseware are rather disparate with regard to their previous knowledge, motivation and intended careers. The notion of links as incorporated in the HTML specifications suffers from some major drawbacks with respect to either challenge:

A link can only be established if its destination is known upon coding the source for the page containing that link. If for example an author decides later on to provide additional information on a specific topic all pages that are to link to that new page will have to be re-edited.

Links to a given page will be broken if that page is removed. If for example an author splits a page in order to better accommodate the topics contained in the original page, all links pointing to that page then have to be updated to the respective locations of the newly created pages. This requires not only a complete check of all pages that could possibly be linked to the page in question but also a certain understanding of both the source and the destination topic.

Human knowledge and human thinking differ profoundly in structure. While the structure of the former is interwoven the latter is in principle strictly linear. This linearity can only be broken by again picking up points of thought abandoned earlier. This pseudo-linearity is commonly realized as a hierarchical tree-like structure.
However, HTML courseware based on this principle tends to resemble what can be done in books. An unstructured linkage on the other hand is hard to use and therefore often rejected by students.
A novel mechanism able to circumvent these drawbacks should hence be able to link the different parts of the courseware using invariant features of the content itself. It must not depend on a specific representation of that content. The mechanism should also reflect possible linearizations that are meaningful to the reader.
We propose a three-step solution to that problem: Firstly, we describe the invariant structure of the course content by means of a simplified type of concept map. We then tag these concepts to the HTML material. In the third step we use the mapping and tagging in steps one and two to dynamically generate HTML pages that have now been individualized for each user.
Concept-based structures are a common tool for providing HTML metadata. Concept maps or graphs are described by several authors as a graphical tool for structuring ideas [1], [2]. Novak presents many examples of how concept maps improve the results of teaching efforts [3], [4]. Based on these and other experiences concept maps have meanwhile been directly employed in several hypertext applications [5]-[9].
This paper is structured as follows. In section 1 we have given an overview of our motivation and the problems encountered during the preparation of our courseware. In section 2 we present our concept map approach and the corresponding tagging mechanism that we developed to handle these problems. Section 3 explains the dynamic HTML generation and gives a practical example. Section 4 reports on the early experience with our tools. In section 5 we summarize our project and draw conclusions.

2. Concept maps and HTML tagging

Thinking is often equaled to speaking. Particularly if we also consider non-verbal symbols to be words in an abstract language. In this sense, words or phrasal combinations of them are the building blocks of our thinking. They reflect our concepts of a certain subject. Naming concepts is a major activity during the cultivation of new areas of knowledge. And being able to appropriately name and relate concepts during a dispute is taken as a sign of understanding.
Relying on this fact we made concepts the features on which we base our linking. Concepts, however, should not be confused with the words which describe them. The former are essential and unique, the latter somewhat arbitrary. The scientific context often establishes a rather strict terminology, mostly with one, sometimes with two but rarely more equivalent names for a concept. We will consider this equivalence problem later, for the time being taking uniqueness for granted.
As the building blocks of our thoughts and knowledge concepts are glued together by their mutual relations. These in turn can differ greatly in depth and complexity, ranging from easy 'has a'-type relations to more intricate relations such as 'changes color if in contact with' when for example describing an indicator - acid relation. A graphical arrangement of concepts and their relations is called a *concept map* and can serve as a tool for structuring one's knowledge. Some authors explore more complex mappings where relations can also be equipped with attributes, e.g. further concepts.
For our purpose that multitude of relations disturbs the automated handling of concept maps. Relations in our initial prototype were restricted to the following three types: 'requires an understanding of', 'explains' and 'is an example of'. While this simplified the coding and usage of the concept map it also spoiled the clear definition of concepts. Information had to be incorporated into the concept that originally should have been contained in the relation. An example presented in the course is no concept in the original sense but content related to another concept already defined in the concept map.

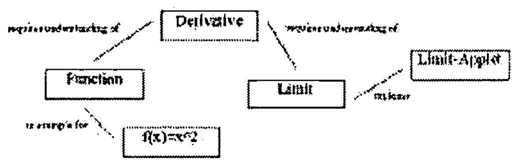

Figure 1: Simplified example of a relation structure used by our initial prototype. Concepts are linked to other concepts by three kinds of relations: 'requires an understanding of', 'explains' and 'is an example of'. The distinction into different types of relations depending on the didactic use of a piece of content spoils the clear definition of concepts.

Although our initial prototype that incorporated this scheme was rather successful we improved the scheme of concept maps. This new, improved scheme more clearly separates the two types of concepts which had been mixed in the initial prototype. Concepts describing the content itself and the associated didactic aspects are now handled by two different concept maps. The first contained concepts like "Function" and "Derivative", the second, concepts like "Introduction", "Example" and "Exercise". Didactic concept maps are much less complex and hence treated differently in our system. The content concept maps on the other hand have now degenerated into a prerequisite map, i.e. all relations have the meaning "is prerequisite to". For later reference we call concepts that are prerequisite to a given concept "ancestors" of that concept.

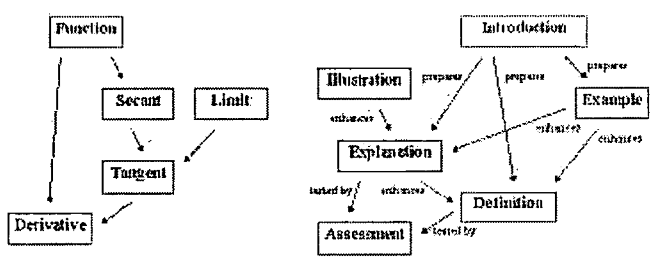

Figure 2: Simplified example of content concept maps (left) and didactic concept maps (right) used in our improved prototype. Content concept maps describe the relation "is prerequisite to". Pieces of content in our courseware are tagged using both content and didactic concepts. This allows for individualized linerarization of the material.

The HTML courseware is now tagged with pairs consisting of one concept from each category. Each piece of content is provided with a concept name and a tag indicating its didactic function.

```
<CONCEPT NAME= "Derivative" TYPE= "Definition"> The function mapping x to the
slope of the tangent to the function f in x is called the derivative of f. It will
be denoted by f'. <\CONCEPT>
```

This tagging can be done in parallel to the authoring of the text itself. Different authors have only to agree on the didactic concepts, i.e. they must have a common idea of basic didactic tools like introductory texts, examples and exercises. However, no further structural definition is required. Concepts can be identified by the author of the respective part of the course. Overlapping material is then combined automatically by means of the content concept map and the tagging in the HTML source.

3. Dynamic HTML generation

The content and the respective concept maps can be used in two ways. The first integrates the capability to deal with concept maps into the browser. The second possibility employs a modified HTTP server which itself processes the pages before they are shipped to the students.

Since our initial prototype pursued not only the integration of these concept-based navigation facilities but also more elaborate multimedia integration of mathematical texts and Java applets, we implemented a special browser in Java. Here Java animations could be seamlessly mixed with the bitmaps created from LaTeX sources, providing full rendering of all mathematical formulae without the usual hurdle of having to mix HTML and GIFs..

The improved prototype is currently implemented as a Java application running on the course's web server. The applets communicate the assessment results to that server process and receive in return the URL for the next course segment.

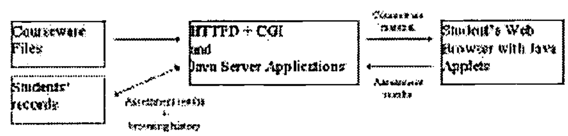

Figure 3: Brief outline of the data flow in our courseware. The sources containing the concept tags are stored on the web server together with the students' records. A mixture of CGI-scripts and Java applications ship the HTML pages to the browsers and maintain the records with the assessment results provided by the Java applets on the client side.

With the help of the concept map and the concept tags we now generate HTML pages that are transferred to the student's browser. The browsing history of each student is logged on the server together with the students' results obtained in the assessments. If a student's result is better than the defined threshold of 0.5 the prerequisite relation is assumed to have been satisfied for that student. A concept is said to be established if all its ancestors have been established and all its prerequisite relations have been satisfied. This mechanism provides at each point in time a set of concepts with fully established ancestors. From this set and according to the didactic concept map the server chooses a piece of content that is next shown to the student. Presentation of a new concept will typically begin with an introductory part. Where no introduction has been provided the server will choose an example to enhance an explanation or definition. Finally the student will do some exercises and take some tests as an assessment. Sufficient performance on these tests then establishes the concept.

In the common case that there are several concepts with fully established ancestors, the student is presented with several possible tracks. This provides the greatest possible freedom to the students while guaranteeing a sound trail of study.

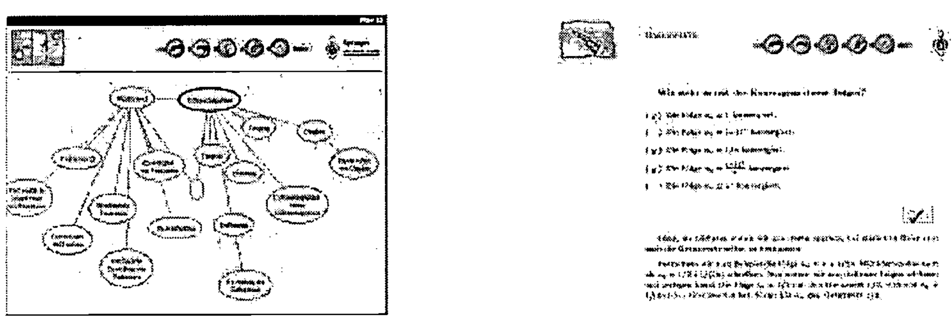

Figure 4: Screenshots from our intial prototype. The left hand side shows a content concept map for the current concept and its nearest descendants. On the right hand side a typical page from the course itself is shown. Besides multiple choice questions tests can require entering of numerical values and simple formulae.

BEST COPY AVAILABLE

In our implementation we paid less attention to the students' browsing history, relying more on their assessment results. This allows the students to quickly pass through topics that are already clear to them. Accordingly the courseware provides introductory pages that sketch the problem and directly lead to relatively tough questions and tests. Students are free to try these questions to quickly establish the concept or take the long way through the explanatory pages of the course.

4. Early experience

Two main reasons inspired us to investigate the techniques described above. Firstly, our students have a vastly disparate previous knowledge of the mathematics taught in our course. Secondly, the hypertext material and the accompanying Java applets are in constant evolution. Especially this issue could not have been handled conventionally. During the two years of this project the text for the entire course was rewritten three to four times, not counting the dozens of minor changes like splitting and combining chapters, or the insertion of new examples and deletion of old ones. Finally the exercises and tests were modified almost daily. During this time the course was taught by five professors and two more lecturers provided additional material.

Despite this ongoing evolution we were always able to provide the students with a working prototype of the course. That prototype could be handled by a single person, who administered the web and video streaming servers and supervised the students programming Java applets for the course. Our approach greatly reduces the amount of work required to maintain our teachware.

Students were also very impressed with the possibilities. Although the staff members did offer tutoring in persona the students used the electronic courseware. After the two-week introductory course more than 90% expressed the opinion that this courseware could provide them with significant tutoring if no traditional tutoring by staff members was available.

However, the results are somewhat unsatisfactory since the capabilities of our system were not really tested independently of the traditional course. A profound analysis can only be done if students work solely with the electronic courseware. Since our program is scheduled to be published by a large scientific publisher in 1999, we are confident we will soon obtain real data on usage and performance of our courseware.

5. Conclusions

Transforming tutorials that have been traditionally held by staff members into interactive courseware is a challenge for two reasons: Several authors, each with their own ideas and objectives about the course, contribute simultaneously to the teachware. The resultant constant evolution hinders any centralized planning. Secondly, the students differ greatly in their previous knowledge and are interested in different aspects of the course. It was hence necessary to design a mechanism that is able both to combine different contributions without the need to define a fixed structure or hierarchy of the content and to allow for individualized linearizations of the material.

We chose concept maps as the base for linking the different parts of the course. Content concept maps reflect the structure of the topics taught while didactic concept maps describe the different functions of the individual pieces of the course. Both concept types are used to tag the source of the courseware. Server applications then dynamically generate HTML pages that are shipped to the students' browsers.

The system has proven very successful. Despite the constant changes in the course a consistent view of the material could be given at any time. The necessary maintenance work was minimal. On the other hand, students could quickly navigate the material since the system was able to present them the material best suited to their individual level of competency. We are confident to soon be able to provide a thorough analysis of the capabilities of our system since the courseware is scheduled to be published for general use in 1999.

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Creating a Postgraduate Virtual Community: Assessment Drives Learning

John Hedberg
john_hedberg@uow.edu.au
and
Shirley Corrent-Agostinho
shirley_agostinho@uow.edu.au

Faculty of Education
University of Wollongong
Australia

Abstract: Increasingly universities have supported several innovative flexible learning projects over the past few years, and there exists a small but enthusiastic group of staff who have demonstrated that something is possible. Our task is to suggest additional strategies that can realise some of the strategic goals set for Flexible Learning over the next few years. This paper is based upon the assumption that a strategic direction has already been chosen and suggests some strategies to ensure practical and realistic outcomes.

Introduction

The notion of flexible learning is that of providing students with choices about when, where and how to study. Through flexible learning programs we can begin to cater for individual needs in a higher education system that is expanding to accommodate an increasingly diverse student body. Flexibility can be introduced in a number of different forms that include:

Flexibility in time: Tuition is not restricted to a set schedule of events. Rather, students can choose a time that is of most convenience to them and their lifestyle.

Flexibility in place: Students are not restricted to coming to the University campus to attend teaching sessions. Learning materials can be accessed from both on and off-campus.

Flexibility in the curriculum: Students are provided with choices in the teaching resources and methods to best suit their particular learning needs.

Flexibility in pace: Students can progress through a course at their own pace in accordance with their academic background, and personal circumstances.

Traditionally distance education programs have provided some flexibility in that they provide choices in the time and place of study. Teaching programs were usually delivered using a number of different resources most commonly print, audio and videotape. However, there has been a strong distinction between the course offerings and learning experiences of students studying on and off-campus. The more recent notion of flexibility is one that aims to bridge the gap between on and off-campus contexts by providing all students with substantially the same teaching materials and learning experiences. Thus students are truly provided with a choice.

> Flexible learning is concerned with access, free of the constraints of time and place, and organizational structures, and in the presence of dialogue and other student support systems. (Kirkpatrick, 1997, p.166).

Fleming (1993) suggests that flexible learning is taken to mean:

> …the organization and resourcing of learning in ways that shift the emphasis off the traditional format of lecture and seminar, with its tendency to reinforce a one-way conception of teaching and learning as the dissemination of wisdom from teacher to learner. Flexible learning offers the learner a more actively constructive role by providing a framework in which learning goals can be more independently pursued (Fleming, 1993, p.322).

When reviewing the implementation papers at her university, Kirkpatrick (1997) identified four different discourses of flexible learning:

- *Flexible learning as efficiency*. A concern of academics in that they feel that more pressure is being placed on them to teach more students with the same or declining resources.
- *Flexible learning as the competitive edge*. This is incorporated into the university's strategic plans to initiate flexible learning approaches.
- *Flexible learning as equity and access*. A frequent statement in the flexible learning strategy.

- *Flexible learning as information technologies.* This is part of every dialogue, while saying information technology does not equate with flexible learning, there are often plans for some use of the Web.

And in several institutions, there is also a fifth discourse:

- *Flexible learning as a strategy to increase the quality of learning experiences.* This discourse is in line with newer approaches to learning theory and the advent of constructivism as an increasingly dominant philosophical approach to learning (Jonassen, Mayes, & McAleese, 1997).

The Role of Technology in Facilitating Flexibility

With the convergence of computer and communications technology through the World Wide Web, we now have the capacity to offer enhanced forms of flexibility. The capacity of the Web to hyperlink and layer information, provide interactivity and support multimedia formats makes it a valuable and exciting tool which can used to develop, deliver and manage flexible learning programs. At its simplest the Web can be used to coordinate and manage learning and act as a point of communication for staff and students. At its most sophisticated it can be a virtual learning environment that facilitates the entire educational process.

However, while the technologies can be used to increase the quality of the learning experience, by rigidly re-packaging the curriculum rather than re-conceptualising the learning required for a particular knowledge domain, it is possible to lock students into the need to use technology when they are loath to do so. Without thought the exercise may simply be converting the learning experience from a group listening experience to an isolated and singular one.

Several studies have pointed out that the way in which information technologies are integrated becomes critical to their effective use. In many institutions IT is "bolted on" to each of the traditional operations and practices, they in effect become adjuncts to traditional classroom practices. More importantly, they need to be reconceptualised so that they are joined in new integrated combinations of classroom teaching and new configurations of older media and technologies as appropriate. It is logical to expect that in time, the second approach will help to redefine the relationship between teaching, and research for each academic. In particular, new on-line technologies can potentially redefine the relationship between student and teacher, enabling non-sequential, concurrent and collaborative relationships. Moving toward the extremes might mean that databases of resources (including multimedia and other new forms of data display) can be individually structured for each course and accessed as required by students. These resources can be grown by staff and student and eventually hold contributions by multiple stakeholders.

The growth of the Web and the movement away from individual technological implementations such as one CD-ROM or a computer assisted learning package (CAL) has produced an environment which integrates a range of teaching and learning functions. For example, the web enables not only the presentation of ideas including using multimedia forms but also computer mediated communications (CMC) in discussion spaces and chat rooms, together with computer managed learning (CML) using password testing and result collating software like Topclass. In effect this enables the mass production of a series of useful products for teaching and learning. For instance, it is possible to collect a set of readings, case studies and other resources and the select from them for different groups of students or different units.

Elements of a Flexible Learning Program

Several design, developmental, implementation and management issues need to be considered when introducing flexibility into educational programs. All teaching and learning resources must be firmly grounded in the aims and outcomes of the unit. The introduction of flexible resources will also require new approaches to teaching and learning. Both students and staff may need assistance in accommodating these new approaches.

In moving a subject into a flexible framework, decisions need to be made about how flexible is it going to be. Remembering that the greater the flexibility, the more effort is required to keep the records and ensure the students have a chance to experience the required issues in the most effective way. For instance, the 14 week session might be required as the basis for group and joint project work. It is very difficult to create groups to work on joint problems if they are all at different stages in a subject. The skill in offering alternative study patterns is in the understanding of student learning and how instructional strategies need to be redefined for mediated approaches to learning. Strategies such as problem-based learning might be considered as alternatives to traditional approaches (Boud & Feletti, 1997).

In any flexible learning program there are several options for configuration. Options existing for the way students access the content of the subject, options also exist for the way they are assessed, and the forms of collaboration that are possible. Traditional essays and examinations are of course possible within any flexible framework. However, as the nexus between attendance and geography is broken, the assessment patterns and forms can provide some challenges: both for marking and in new forms of assessment. Marking assignments is not easily undertaken electronically. Reading and correcting documents on screen is a learned skill. However, many students will submit assessments through e-mail and use a variety of word processing software awareness of the options will be necessary and be reviewed regularly. However, there are also tools that enable a quality turnaround, consider the use of the revision tools in Microsoft Word which will enable a marker to annotate the submission in a different colour font.

One technique that might be applicable in several knowledge domains is the exercise of getting the students as part of their assessment to complete some form of Web document that can form a basis for other students learning. Instead of writing traditional essays, the document could form a guide to a new area of study. It might also be a series of discussion summaries which would be undertaken verbally in a face-to-face class but the on-line class might rotate the task of summarising the computer mediated chat sessions. In many subject areas such as information systems and communications, producing a product that embodies all the attributes being discussed in the class is the most obvious method to test for application and transfer of the principles learned.

The challenge is not necessarily one of adding to the knowledge presentation, rather it is the unlearning of traditional ways and re-conceptualising other ways of achieving similar outcomes with less demand on staff and less demand on redundant systems. Realistically, universities are increasingly in a competitive environment and the options for some might be solved by electronic access to prestigious institutions such as: Harvard and Stanford on-line. From the work described in this paper, provided that the cost differentials are appropriate, face-to-face access to a local academic will be more appealing to many students.

An Example of Implementing "Flexible Delivery"

The availability of the Internet is facilitating a change in teaching and learning strategies as Universities take up the challenge of investigating flexible modes of delivery in contrast to the traditional fixed time and place lecture style format. This account describes the first two implementation cycles of one particular postgraduate subject and illustrates the change that has occurred in terms of the learning process and the nature of assessment by virtue of the technology used.

Implementation Cycle One: A Postgraduate Virtual Class

In 1996 the postgraduate subject: *Implementation and Evaluation of Technology-Based Learning* was chosen as a pilot study to trial World Wide Web and videoconferencing technologies. This subject had previously been offered as two separate classes on two separate evenings; one held on campus, the other held in Sydney (80kms north). The use of the Web and videoconferencing would allow both classes to be held on the same evening with one instructor/lecturer.

The two geographically separate classes met each week on the same evening for three hours during a fourteen week semester. There were eight students and a participant observer in the on-campus class and six students in the Sydney class. The instructor physically met with each group on alternate weeks. Interaction between the two sites was facilitated by a class web site and videoconferencing except for the last week when all the students, the instructor and the participant observer met face-to-face.

For assessment purposes, students were required to complete three pieces of work:

1. A seminar presentation of an agreed topic to facilitate learning and discussion (30% of final grade). This task was to be conducted as a collaborative exercise between two students, one from each site. Students were to lead a discussion for the entire evening and provide online activities to engage the virtual class. A web page was to accompany the presentation and each student was required to submit a piece of writing, in the form of a publishable paper for assessment. The paper was due three weeks after the seminar presentation or at the end of semester, whichever was earlier.
2. A portfolio of resources relating to implementation and evaluation of technology-based learning (40% of final grade). Students were to compile useful articles, evaluation instruments, web sites, etc. that would help them further their understanding of the issues raised in the subject. Each item collected was to be accompanied by a short reflective piece that explained its selection as a useful resource. The portfolio was due at the end of semester.
3. An evaluation of an educational software package *or* a review of the implementation of this subject as a technology-based learning project (30% of final grade). Th evaluation report was due at the end of semester.

Content delivery was structured so that a new topic was addressed each week. The first five weeks consisted of instructor-led discussions and workshops and the remaining nine weeks were designed as student-led seminars. Figure 1 depicts the model that emerged from this subject.

The themes that surfaced from this implementation are summarised as follows:

- **Nature of interaction**

On-line interaction was predominantly synchronous in nature. "Synchronicity" was encouraged by the nature of the course design that was structured to present new content each week. Due to much social interaction taking place within each physical class, the role of the web site became a storage mechanism for student seminar web pages and a pointer to the online discussion tools.

A problem-based approach was used to facilitate online interaction. All the online discussions were structured around a problem or a series of questions that students needed to answer. On-line interaction occurred mostly during "class time" and was not linked to an assessable task. The quality of discussion was influenced by time constraints and it is contended that the incentive and motivation for students to engage in meaningful discussion was affected by the non-assessable nature of the tasks.

- **Nature of student activity**

Students attended class each week and worked either individually or in small groups when contributing to the online class discussions. Apart from a small group exercise that was organised in the early weeks of semester and pair work that occurred for some of the seminars (not all students presented in pairs), there was little need for group collaboration.

- **Nature of assessment**

Grading was based on individual work submitted. The majority of assessable work was due at the end of semester. (Seminar papers were submitted from Week 9 to Week 14).

- **Nature of content**

Content material drove the learning process. Each week students attended class expectant to address a new area of content. Upon reflection, the strategies implemented to present content and encourage student interaction (both in the physical groups and online) were couched within a traditional university lecture framework of fixed weekly meetings (see Agostinho, Lefoe & Hedberg, 1997 for specific examples). The technology was used to facilitate a weekly "virtual class" and little asynchronous discussion transpired.

For the subsequent implementation we felt that the features of asynchronous communication could be better utilised and tasks given to students could provide a more flexible and effective learning environment. The reliance of fixed-weekly meetings could be reduced. In an asynchronous mode students would be able to spend more time discussing an issue and contributions to the discussion could occur outside the set "class time". Face-to-face meetings or workshops could then be better utilised to discuss student concerns, resolve problems or provide technical "skilling" workshops. However, to implement this concept requires a change in the learning process. In this case the content and weekly meetings drove the learning process. In the following implementation we wanted to use the assessment tasks as the facilitator of the learning process.

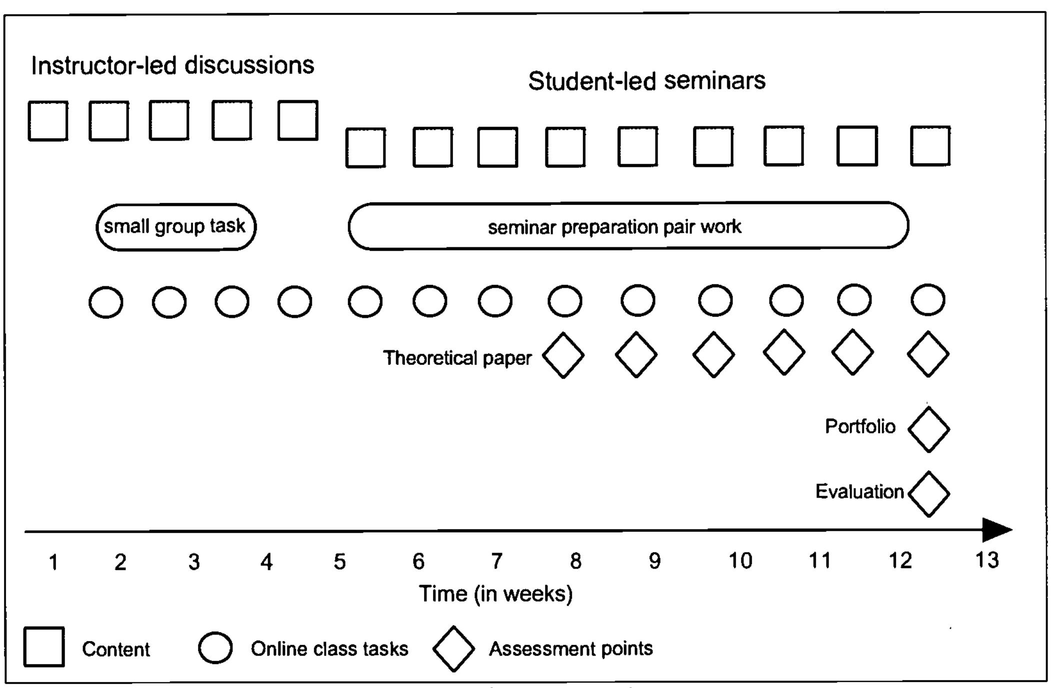

Figure 1: Virtual Class with a "Content" Focus

Implementation Cycle Two: A Postgraduate Virtual Community

In 1997 the subject was restructured to encourage a more flexible asynchronous approach. During the fourteen week semester, students attended eight class meetings (Weeks 1, 2, 4, 6, 8, 10, 11 and 14) and were to participate in asynchronous and synchronous online discussions during the non-meeting weeks. The two geographically separated groups (eleven students and a participant observer in the on-campus class and six students in the Sydney class) met for three hours on different evenings and the instructor was physically present in each group. A class web site facilitated interaction between the two groups and amongst all the students outside class time.

Assessment tasks were restructured as follows:

1. A written paper based on class and online discussion about evaluation theory and its relevance to technology-based learning was to be completed by Week 4 (Worth 30% of final grade).
2. A Web Study Guide on an agreed topic to facilitate learning and discussion was to be completed by Week 8 (Worth 30% of final grade).
3. An evaluation of all the Web Study Guides was to be completed by Week 11 (Worth 10% of final grade).
4. An evaluation proposal for a technology-based learning project was to be completed and presented as a group project in Week 14. (Worth 30% of final grade).

Tasks were completed at various intervals during the course rather than submission at the end of semester. In doing so, the assessable tasks became resources that students accessed to assist them with the final group project. Thus, the first three tasks act as "stepping stones" to the final group project.

The delivery of content was structured with a task focus. Content material was provided to help with the completion of an assessment task. The concept of a Web Study Guide replaced the need for content to be presented in class time in a sequential sequence as the content is in an electronic form that can be reviewed by students at a time and place convenient to them.

The instructor incorporated several online tasks during the semester. The first online task involved students working in small groups to asynchronously discuss the content required for the first assignment. Each group worked on different content and posted a summary of their discussions on the class web site. The intention was that students could then view the summaries from the different groups to help them write the first assignment. Other online tasks included synchronous and asynchronous discussions about particular readings. The model that emerged from this implementation is illustrated in Figure 2.

The themes that surface are summarised as follows:

- **Content, on-line tasks and assessment are integrated**

Delivery of separate chunks of content was replaced with an "assessment chunk". In this model, content material and online tasks support the production of an assessable piece of work. The technology is used in a much more integrated way as web page summaries and Web Study Guides are then available as resources.

- **Nature of student activity**

In the early weeks of semester, students engaged in group work and produced a group summary to assist in the completion of the first assignment. Asynchronous discussions were encouraged to discuss readings whilst production of the student's individual Web Study Guide took place. Then a period of individual self-paced work occurred when each student reviewed other students' Web Study Guides. Group work then occurred for production of the final group project. Therefore, although students did not meet each week there was a sense of community as they were involved in either physical group work, online class discussions or reviewing other student's work.

It became apparent that for many students the non-meeting weeks were viewed as a "week off". In summary, the feedback obtained through a questionnaire suggests that students are still working to come to grips with this way of learning. They exemplify the concern by asking for more incentive, more time, more structure and more guidance.

- **Nature of on-line interaction**

There were varying patterns of online interaction during the semester. For example, as students were busy with Web Study Guide production the online environment became very quiet. Students expected facilitation in the online discussions mainly from the instructor. There was little spontaneous online discussion, although some students did attempt to initiate online contact.

- **Nature of content delivery**

More than half of the class thought that reviewing the Web Study Guides was an effective learning strategy in comparison to sitting in class listening to the traditional student seminar presentation. As Web authoring tools become easier to use, it is possible for students to use such tools to construct their own interpretation of the course content. In effect, they can use the Web environment as a cognitive tool (Reeves & Reeves, 1997). The learner is the designer (Jonassen & Reeves, 1996). The student becomes the author.

- **The evolving nature of the on-line environment**

By producing a Web Study Guide and then using the Web Study Guides as background for the final project, students are creating resources. This becomes a resource-based learning environment (Hannafin, 1997). This evolving dynamic nature of Web-based resources means that subsequent groups of students can access previous student products and on-line discussions which enables the concept of "learning on the shoulders of others" to result. (Hedberg, Brown, Larkin & Agostinho, in press) Unlike delivering a traditional face-to-face course where the same content is presented over and over again and the same assessment tasks assigned, this dynamic learning environment enables students to learn from their predecessors taking "learning" to a new plateau.

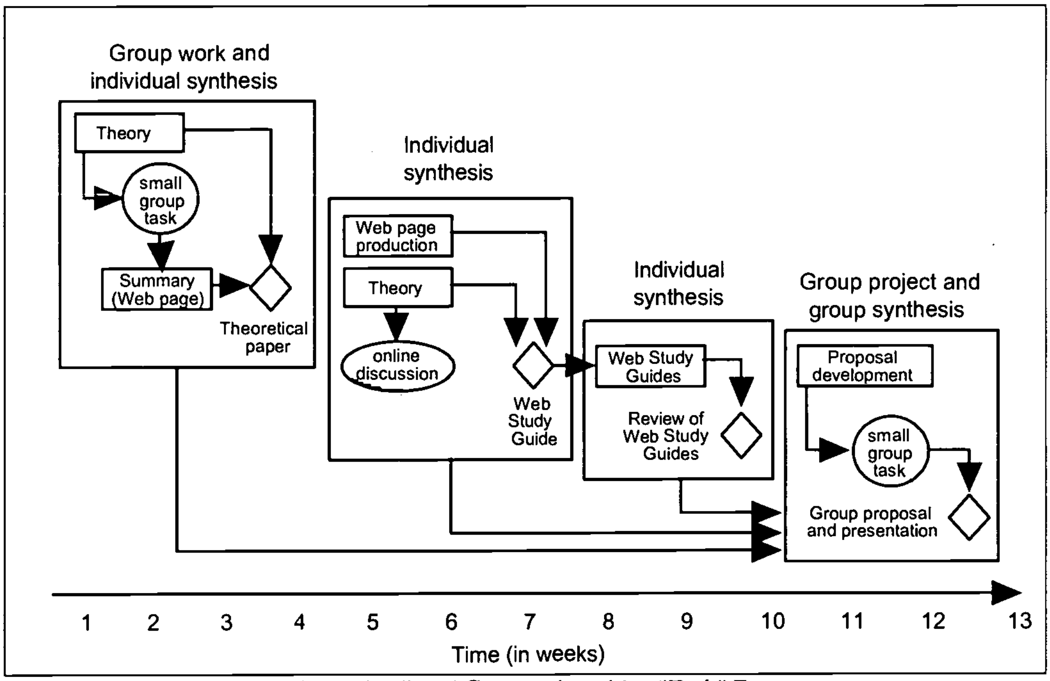

Figure 2: Virtual Community with a "Task" Focus

Conclusion

The focus of this paper was to discuss the rhetoric and the required infrastructure for the flexible delivery of courses in different ways within a traditional campus and to illustrate an example of how one subject has changed to a more flexible delivery approach. As the nature of academic discourse changes, it will be expected that the infrastructure and the courses offered flexibly will become more commonplace. Often postgraduate students seek out potential places to study based on course and common interests; this paper has described how technology can be used to promote a virtual community to provide a flexible yet effective learning environment.

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Analysis of Trends in Delivery Systems for Training

Steve Schlough
University of Wisconsin-Stout
144 Communications Technologies Building
Menomonie, WI 54751 USA
schloughs@uwstout.edu

Abstract: This paper discusses the emerging trends in the use of delivery systems in the field of training and development, the process used to explore those trends, lists identified trends and makes recommendations on how to implemented those changes in the curriculum of a Masters of Science program in Training and Development.

Introduction

There is a well-documented need expressed by business, industry, military, government, and education to more effectively deliver training. This need is bound to increase as the demand for training increases and organizations want to enhance the quality of training while containing cost. To meet this need media systems are becoming increasingly important in the effective and efficient delivery of training and are changing at rapid rate.

The Situation

The University of Wisconsin-Stout (UW-Stout) offers a graduate level program in Training and Development. The "hands on-minds on" portion of the program emphasizes integrating theory with practice to design, develop, and delivery training programs. Previous studies and reviews of the current literature, indicated there is a need to monitor and continually enhance the delivery of training through the use of mediated delivery systems. Feedback from the Training and Development program advisory committee, employers and graduates reinforced this need.

In a 1995 study (Furst-Bowe) recommended that programs in training and development need to review their instructional technology courses and competencies. The study also found that there is a need to examine the professional development needs of trainers in the area of instructional technology. A 1996 (Schlough) study found that it was important for all UW-Stout graduates to be able to create multimedia presentations and participate in videoconferences. The study also stated because of rapid changes in the competencies needed in the workplace that educational institutions continually monitor those changes.

Literature Review

The following chart from longitudinal studies conducted by the American Society for Training and Development (http://www.astd.org/virtual_community/research/bench/96stats/graph13.gif) shows the changes in the use delivery systems over a three-year period and gives an overview of current delivery systems.

Percent of Companies Using Selected Delivery Systems (1994-1996)

	1994	1995	1996
Classroom	97%	100%	100%
Advanced Technology Classroom	53%	56%	47%
Televised Distance Learning	47%	64%	69%
CBT	72%	90%	84%
Interactive/Multimedia CBT	47%	85%	81%
Internet/Network-Based Electronic Distance Learning	12%	33%	53%
EPSS	34%	45%	37%
Other Self-Paced Delivery	66%	77%	75%
Other Delivery	12%	10%	10%

Note: Definitions available.

ASTD Benchmarking Forum

Table 1: ASTD study of the use of delivery systems in training. Definitions of the delivery systems follow.

Classroom (Instructor-led lecture)
Definition: Classroom training that is lecture- or discussion- based. Also referred to as instructor-led. Does not include advanced technology, interactive classrooms, or electronic distance learning.

Advanced technology/interactive classroom
Definition: An advanced technology/interactive classroom is an instructor-led classroom with some degree of automated facilities, including student response units.

Televised electronic distance learning
Definition: Televised electronic distance learning refers to teleclasses broadcast via satellite, microwave, telephone lines, or other means. May or may not be interactive.

Internet/Network-based electronic distance learning
Definition: Internet/network-based electronic distance learning refers to CBT classes made available via Internet or other electronic networks. May or may not be interactive.

Computer Based Training (CBT)
Definition: CBT uses a computer as an integral part of an instructional system, with the learner engaging in real-time interaction with the computer.

Interactive/Multimedia CBT
Definition: Interactive/multimedia CBT uses any two instructional media together; interactive multimedia platforms, typically employ a computerized learning programs that are learner-controlled. Learning response will initiate one of several program sequences, and can be presented in video form as still shots, regular, slow, and fast speed motion. May include sound and other features.

Electronic performance support systems (EPSS)
Definition: EPSS is an integrated computer program that provides any combination of expert system, hypertext, embedded animation, CBT, and hypermedia to an employee on demand. Electronic performance support systems allow employees to perform with a minimum of support and intervention by others (e.g., help systems, electronic job aids, expert advisors).

Other self-paced instruction
Definition: Other self-paced instruction represents any other method of instruction not identified above where the learner controls the rate of instruction. Typically does not require advanced technology or unusual equipment. Includes such methods as paper-based instruction using training manuals and videotapes

Among the future trends appears to be the movement toward more Internet delivery of video and more video simulation. John Chambers (1997) CEO of Cisco felt that training video distributed over networks will be the application that drives the growth of PC networks. McLean (1997) discusses that the use of digitized images and video to create simulations for training has the potential to become a $4 billion market.

Based on these findings, the following actions were taken to assure that the course, *Delivery Systems for Training,* stayed current and continued to meet the needs of students in Training and Development program at UW-Stout.

Methodology

To discover new trends related to delivery systems, it was originally proposed to do an in-depth phone needs assessment and a series of site visits. It was felt the from the literature review and other information obtained that it would be prudent for the Communications, Training, and Education Department to obtain a digital video to allow students to easily integrate digital video into their projects. A grant proposal was submitted to the Stout University Foundation to cover these items. Funding was provided to purchase the digital video camera, but was not adequate to carry out the in-depth research project. A Hitachi MP-EG1A camera was purchased and produces acceptable results.

As it was not possible to do the research as planned, an alternative was implemented. Taking in to consideration that the students in the course Delivery Systems for Training were graduate students and the trends continually change, the trend analysis was turned into the following student project, which was assigned during the Spring semester of 1998. There were 9 students enrolled in the course.

Trends in Delivery Systems for Training

You will need to explore future trends related to delivery systems to be proactive in this rapidly changing and critical area for training and education. To discover new trends related to delivery systems you will conduct a trend analysis. This analysis, quantitative in nature, will focus on obtaining data from individuals who develop leading edge training programs. As a class you will develop the trend analysis instrument and procedure. Each student will contact one respondent, either by phone or in person to answer of "What do you feel will be the biggest change in delivering training over the next ____ years." or similar question(s). Each student will write up a write up a one to two page paper on his or her findings. You will exchange papers and develop a presentation based on the findings. The presentation will be presented during the final class period. Before you conduct your interview make sure the class has came to a consensus on the instrument, the procedures, format for the paper, and format for the presentation. Make sure **NO ONE** contacts the same site and you have my approval before you begin.

Evaluation Criteria

Paper

Format	0 1 2 3 4 5
Technical Execution	0 1 2 3 4 5
Content	0 2 4 6 8 10

Total ____

Team Presentation

Delivery	0 1 2 3 4 5
Visual Appeal/Technical Execution	0 1 2 3 4 5
Content	0 2 4 6 8 5

Total ____

Your evaluation by your peers is worth up to 15 points

You are to evaluate the other members of the class on their role as a team member in the trend analysis project. You should rate each member on a 15-point scale. I will average the scores your classmates gave you and that will be the number of points you earn. The following questions should help you evaluate your team members.

Was the individual cooperative?

Did the individual take initiative?

Was the person open-minded and accepting of other's ideas and opinions?

Did the individual contribute a fair share to the success of the group?

Did you feel the person acted in a professional manner?

Did the person keep the goals and objectives of the group in mind?

Did the individual complete their designated tasks in a timely fashion?

Did the individual submit materials that were accurate and composed well?

Was the individual in attendance and punctual for group meetings?

How would you rate this person's overall ability to function as an effective team member?

The students meet as a team and developed procedures and the following research questions:

What training delivery systems has your organization used in the past 5 years?

What delivery systems do you currently use?

What delivery systems to you expect to be using in the next 5 years?

What constraints does your organization face with the development and use of training delivery systems?

The students contacted a luxury hotel, a national computer manufacturer, an international computer component manufacturer, a national brewing company, a regional high-tech manufacturer, a public utility company, a leading manufacturer of innovative products, a university, and a national aeronautics company. The results of their study are presented in the next section.

Results

The following is a composite the challenges and constraints that were identified:

- Money & Budget

- Time
- Justification
- Development
- Selection
- Time to Train
- Geographic
- Information Systems Support
- Staffing
- WWW Access
- Language Barriers
- Management Support
- Training Quality
- Soft Skills
- Shifts
- Process Changes
- Apathy Toward Training
- Union (Trust Issue)
- Keeping Up With Technology

The following table identifies the use of delivery systems in organizations:

SYSTEM	*PAST*	*PRESENT*	*FUTURE*
Instructor Led/Classroom	9	9	9
Self-Directed Study	4	5	4
CBT/WBT	5	7	9
OJT	3	5	4
Video / Audio:	6	7	4
Satellite Downlink:	1	1	3
Video Conferencing:	2	4	2
Intranet:	0	0	3
CD-ROM	0	3	3

Table 2: Use of identified delivery systems.

Summary

This method of research proved to be a viable alternative to the originally planned research. Although, the results of the research were based on a small population they appear to give a good snapshot of what is happening in training delivery systems. The same project was repeated in the Summer of 1998 with thirteen students contacting thirteen different organizations and producing similar results. The advantages of this methodology is that the students individually talk to a training manager, collaborate at the beginning and end of the project, spend time to together discussing their results, get current results, and have a sense of ownership in the results. It is planned to continue to use the project and refine as time goes on.

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From Research to Teacher Professional Development to Technology and Back Again: The development of *A Video Exploration of Classroom Assessment*

Karen Cole and Christina Syer
Institute for Research on Learning

Abstract: This paper describes a research-based process for the development of teacher professional development materials. *A Video Exploration of Classroom Assessment* is a CD-ROM-based set of assessment workshops designed to be used by small groups of teachers at their school settings. Unstaged classroom video of assessments is a key feature. At the Institute for Research on Learning, we incorporated ongoing teacher professional development and assessment research into every aspect of the development of our assessment CD-ROM. Everything from the target audience and setting to the interface design incorporated research findings. This has resulted in an extremely functional and usable product, which itself can help us organize future research.

Introduction

If you're a teacher, the opportunity to watch the goings on in another classroom is a rare and exciting thing. The opportunity to talk about your observations with a group of teachers, and plan experimental teaching based on your discussion, is still more rare. Even more unusual is the opportunity to obtain perspectives and advice from teachers who have tried similar experiments.

This paper tells the story of the development of a CD-ROM called *A Video Exploration of Classroom Assessment*. This assessment CD-ROM gives teachers all these opportunities as they work to develop their repertoire of classroom assessment strategies. Teachers can view classroom video of assessments in a real classroom, and get perspectives of teachers and students who have tried the various assessment strategies. The CD-ROM includes complete workshops for teachers who want to develop assessment strategies together.

The story of the assessment CD-ROM is important because it illustrates the crucial symbiosis and synergy between educational research and educational product development. The assessment CD-ROM was developed at the Institute for Research on Learning (IRL). IRL is committed to a research strategy that is deeply embedded in real-world practices. The assessment CD-ROM is the culmination of many years of IRL's research in classrooms and in a teacher professional development (TPD) community.

In the next three sections we will describe the research projects that inspired and contributed to the design of the assessment CD-ROM, explain how research findings were incorporated into the design of the CD-ROM, and suggest directions for further research uncovered by our development process.

Historical Overview

An emerging community in MMAP

The assessment CD-ROM grew as the next logical step to a series of research and development projects at IRL. We had formed a community of about 30 teachers who were co-developers of our Middle-school Mathematics through Applications Project (MMAP) curriculum (funded by the National Science Foundation). These teachers worked with us over five years and came to IRL for monthly work days and three-week summer institutes. Work days included MMAP curriculum development activities, math and technology workshops, guest speakers, and collaboration on our research on math teaching and learning. Although nominally about curriculum development, the MMAP teacher community became a rich professional development experience for participants and a research opportunity for us (Lichtenstein, Weissglass et al. 1998; Greeno, McDermott et al. in press).

A year of assessment research

It became clear as the work days progressed that assessment was a primary interest and concern of our teacher community. Because MMAP is a project-based math curriculum, old assessment methods were not always appropriate, and using authentic assessments required learning, time, and effort for many teachers. We decided to conduct research on ways of building classroom assessment systems. We spent a year of intensive work with one teacher, Mona Muniz, developing assessment strategies, testing them in her classroom, and revising our strategies (Cole 1996). We video taped extensively in Mona's classroom and analyzed the tapes at teacher work days. We also solicited comments from our teachers on the assessments we developed. This project continued a trajectory of several years of this type of assessment research at IRL (Moschkovich 1994; Hall, Knudsen et al. 1995/1996).

The Assessment Club

These activities inspired the creation of the Assessment Club, which met monthly at IRL to discuss and design assessment strategies. Teachers, as a result of their participation in Assessment Club activities, began to experiment in their own classrooms, and reported their experiences and difficulties in Assessment Club meetings. Several teachers became experts and resources for the group in particular assessment techniques. Every teacher in the club used new assessment techniques that year, and most began to use a greater variety of assessments (Goldman and Cole 1997). We had a growing collection of very knowledgeable teachers on our hands.

A Video Casebook

Many of the liveliest discussions in MMAP and Assessment Club were inspired by classroom video from members' classrooms. Teachers found reasons to watch the tapes again and again, as they tried to interpret the effects assessments had on student learning. Video supported in-depth discussion and examination of teaching practices in a way that oral or written cases did not. We began to compile video cases that teachers outside MMAP could use to seed discussion about using standards-based math curriculum. The result was a video tape of real classroom vignettes called *Seeing powerful mathematics.* We tested this tape on groups of teachers outside of MMAP and found that their reaction to real classroom video was as positive as that of our MMAP teachers (Goldman 1996).

As MMAP neared completion, we felt the need to develop a product by and for teachers that would capture the diverse and extensive knowledge MMAP teachers had about assessment. Although much of this expertise had been fed back into the development of the MMAP curriculum and support materials, we wanted to reach teachers outside MMAP. We also wanted to inspire teachers to form supportive and dynamic learning groups like the one that had developed in MMAP, and give such groups materials to work with once they had formed. The next section details how all this research work informed the design of the assessment CD-ROM.

Creating a tool for collaborative teacher learning

Valuable communities around assessment had been created, and we needed to find a way to keep this kind of community formation and discussion alive. Looking back at all of our research, what had been the key factors in stimulating discussion and growth around assessment? We needed to answer this question before we started making a tool that had the main focus of producing this type of interaction.

From Research Findings to Technology Choices

We synthesized the findings from our research into five key elements we wanted to preserve as we moved to a technology-based tool:

- *Unstaged classroom video:* In Assessment Club meetings and other MMAP teacher workday activities, discussion and learning had always resulted when the teachers were confronted with unstaged classroom video of assessment in action. This fact alone mandated that we needed to present real classroom examples that would spark discussion around assessment practices. This meant that out tool needed to have a space for video.
- *Access to classroom artifacts:* We saw the tremendous benefit of teachers sharing student work and assessment tools they had created. This meant that along side the classroom video, we also needed to have a space where pictures of paper documents could appear.
- *Multiple Perspectives:* Our teachers had learned from hearing the opinions of the teachers around them. Having multiple teachers' perspectives available in our tool was a must.
- *Workshop structure:* We also realized that we needed to imbed a structure inside the tool that would help teachers find what they wanted and support discussion and experimentation. We decided to organize the content into workshops similar in structure to Assessment Club meetings.
- *Clear and inviting interface:* Lastly, we knew that the tool would have to be inviting and accessible to teachers. For example, in our testing of the *Seeing Powerful Mathematics* video, we found that teachers needed a transcript to hear video conversations clearly, and that they used these transcripts to go back to parts of the video for discussion. Easy transcript management thus became one of many interface requirements for making the whole tool useful to teachers.

Keeping all of these factors in mind, the one piece of existing technology that met all of our needs was the CD-ROM. A CD-ROM would allow us to present classroom and interview video and all the supporting material we needed.

Figure 1 shows how the workshop screen of the CD-ROM is organized. The upper left corner contains the workshop, including prompts for discussion, video watching, student work analysis, and experimentation. Beneath the workshop frame is a frame for showing student work or other artifacts from the video being shown at the upper right. Perspectives from other teachers and students also show in this window. Finally, the lower right frame contains continuously updated transcript of the video currently being played. Teachers can click on any point in the transcript, and the video will begin playing at that point.

Figure 1: Workshop, classroom video, artifacts, and transcripts

The choice of the CD-ROM media thus gave us two powerful ways to meet our goals. First, video, transcripts, and artifacts can all be synchronized within a workshop structure. Second, teachers can quickly and easily access any part of the video and play it as many times as they want to.

Restructuring the video presentation

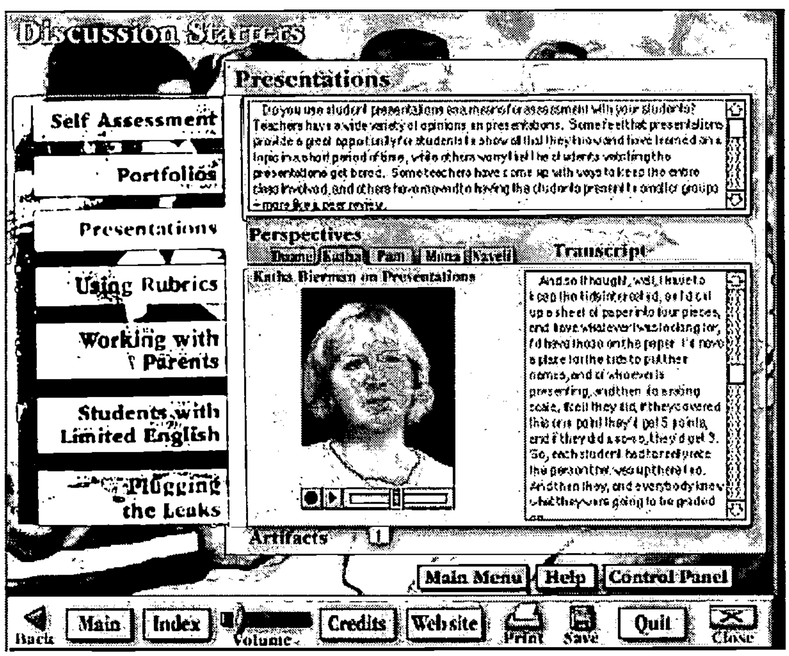
Our first step in creating the assessment CD-ROM, *A Video Exploration of Classroom Assessment*, was to capture the classroom video that would be the core of our disk's content. We turned to a teacher, Mona Muniz, who was a primary collaborator in our assessment research. Our first inclination was to follow her through an entire year of her classroom assessment. This approach matched our research techniques, where we often taped weeks of class in chronological order.

When we brought our research team together to look at the tape we were gathering from Mona's class, we grew dissatisfied with the chronological organization. We remembered that when teachers went to a piece of classroom video, it was always in the context of a question they had or an issue they wanted to explore. Teachers who would use our tool needed to be able to access video according to their interests and questions. Our unstaged tape needed a new organization.

In considering what a teacher would be looking for when working with a CD-ROM focused on assessment, a natural organization came to the surface. Mona was primarily working with four assessment techniques: peer review, notebooks, walk-arounds, and testing. We decided to group the classroom video on these specific techniques, so that teachers working with the disk could focus in on one technique at a time. We also had the video from interviews with multiple teachers and two students. They had commented on specific assessment techniques and issues, and their comments could be paired with our classroom examples. This change from presenting the content in chronological order, as we had been used to doing during our research analysis was a large shift in thinking, and it was critical to the development of a useful teacher tool. Figure 2 shows how teachers can select the six workshops that resulted from the new organization.

Figure 2: Content organized by topic

Figure 3: Discussion starters, teacher interviews, and teacher tools



Realizing that there are many other important assessment techniques and issues outside of those covered in Mona's classroom, we interviewed teachers to explore their experiences with self assessment, portfolios, presentations, rubrics, working with parents, and students with limited English. Figure 3 shows these "Discussion Starters," where teachers who are using the disk can read an outline of an issue, hear from teachers on the disk, and then discuss the topic on their own.

Interface, look and feel, and ongoing development

During the five years of working with teachers on the development of a middle-school math curriculum that included units that involve technology, we saw that teachers' comfort with technology varies considerably. In designing the disk's look and feel, we wanted it to be inviting and intuitive to use. Through every step of the design process, we kept our end goal in mind: creating a disk that would feel inviting, warm, and professional. We combined familiar images of the classroom with a binder-like interface design.

Another challenge we faced during this CD-ROM's production was that we knew that once the disk was finished, duplicated, packaged, and shipped, there was no way to further develop the content presented on the disk. This kind of finality was never felt during the research process. With our research, if another intriguing theme emerged from our data, wc could always start writing a new paper and continue our analysis. We addressed this concern by creating a web site (www.irl.org/assess/assess.html) that can be reached by pressing the "web site" button inside the disk. Inside the workshops, we encourage teachers to go to this web site to report on their use of these assessment techniques. They can also read what others teachers have had to say. This is our attempt to keep the dialogue going and growing outside of the disk.

Preliminary testing and feedback

When we selected the preliminary video segments, we tried them out with teachers to get their reactions. Were we on the right track? We found that the cases that we picked did indeed spark discussion, and teachers found it very easy to talk about the positive aspects of the assessment as well as the ways that they might try to make it better. These discussions highlighted another positive aspect about the disk. It gave teachers a classroom to talk about that was not their own or their peer teacher's. They felt free to comment openly about what they saw, and their reactions were not guarded. The disk gives teachers a credibility for trying new techniques. Having the teachers' on-going feedback about the content inside *A Video Exploration of Classroom Assessment* as well as its design and functionality was invaluable.

When teachers had a chance to work with the disk, here were some of their reactions:

- "I really like seeing the classroom; it feels so real. The teacher perspectives help with knowing how to realistically apply these techniques in my classroom. Very nicely done."
- "I love the assessment CD-ROM; it is wonderful to be inside Mona's classroom. Four other teachers and I get together and watch sections together."
- "It is thought provoking. It gives some concrete suggestions. It stimulates conversation between my colleagues."
- "I am a MSDP Evaluator (Middle School Demonstration Program) for John F. Kennedy Middle School in Redwood City, CA. This school is doing some intensive work in math assessment. In my report to them, I recommended the use of the CD-ROM, *A Video Exploration of Classroom Assessment*, as an invaluable resource for their summer school training of math teachers and training throughout the school year. This report also goes to the State Department of Education."
- "The Assessment CD-ROM is excellent. Our school is planning on using it in our staff development program in August after returning from summer break."
- "Should you develop further materials that explore student learning/teaching in a similar way, I should be most interested to learn about them."

Back again: Directions for research

Now that the CD-ROM is finished, we have shifted our thinking back to research mode. Our field testing has left us with at least three big questions to explore. First, what is necessary to support the many possible uses for the CD-ROM? It is our hope that *A Video Exploration of Classroom Assessment* will be used in multiple settings. The disk is useful to both current teachers who are going through continual professional development as well as to future teachers who are in teacher training programs. Teachers use the disk alone and in groups with other teachers. We can improve our understanding of teacher professional development by exploring how tools are used differently in different settings.

Our second question is, how can we keep the content of the workshops current and continue to spark discussion as teachers' needs change? Web delivery is one obvious future alternative, and others are emerging. Whatever technology we use, our research will continue to drive our innovations.

Our third question is, how does using our tool change what teachers do with their students? We know our disk is successful in that teachers like and use the disk, but we do not know much about what happens in classrooms as a result of this kind of professional development experience.

We believe the tight integration of ongoing, multifaceted research with product development was the biggest factor in the ultimate high quality of our CD-ROM. This connection works the opposite way too: by keeping research in mind through the product development cycle, we have a whole new set of questions to explore.

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A Pre-authoring Environment for the Development of Hypermedia Courses

Clovis Torres Fernandes, Miguel R. Flores Santibañez, Delfa M. Huatuco Zuasnábar
Computer Science Department
Aeronautical Institute of Technology - ITA
Brazil
{clovis, raymundo, delfa}@comp.ita.cta.br

Abstract: Based on the design of a hypermedia application for educational purposes, a hypermedia course developed through some hypermedia model or methodology, it is possible to produce the authoring or effective implementation of the course. To support the effort of designing hypermedia courses, here called pre-authoring activity, one must use appropriate models and tools. This paper presents a pre-authoring environment supporting the development of hypermedia courses, called APACHE. This environment offers supporting tools to simplify the author's task of designing hypermedia knowledge domains, based on a model that incorporates both concept maps and information mapping techniques. It propitiates, still, the automated design of guided-tours for hypermedia courses, according to pedagogic criteria imposed by the author, the target population and the learning objectives. Based on the designs of hypermedia contents and related course guided-tours developed under APACHE, it is possible to implement the hypermedia course easily using any hypermedia-authoring tool.

Introduction

For designing general hypermedia applications several models found in the literature can be used, such as HDM (Garzotto et al. 1993), RMD (Balasubramanian 1994), OOHDM (Schwabe & Rossi 1995), etc. However these models are not suitable for modeling hypermedia courses, since they do not incorporate didactic and pedagogic aspects in its processes of modeling the hypermedia content and related course guided-tours (or trails). To support the effort of designing hypermedia courses, here called pre-authoring activity, one must use appropriate models and tools. The problem is in defining how to design both the hiperbase and related course guided-tours before doing the, strictly speaking, authoring task.

This paper presents such a pre-authoring environment supporting the development of hypermedia courses, called APACHE. The paper organization is the following: firstly the architecture of the APACHE environment and the research context is presented; next the APACHE pre-authoring tools, called SICH and SPR, are showed.

APACHE Environment and the Research Context

For the purpose of this paper, we understand a hypermedia course as including the following:

- A specific hyperbase for the subject
- One or more navigational guided-tours or trails defined on the nodes of the related hyperbase.

where a hyperbase is a base of subject nodes related through concrete links and a guided-tour is a sequence of nodes of the hyperbase.

A guided-tour is a course when it presents a certain subject in a didactic and pedagogic sequence of nodes. In this case, some additional nodes added to the sequence do not refer to related nodes belong to the hyperbase. A guided-tour is a hypermedia course when one or more hyperlinks in a number of nodes belonging to the sequence is active, except forward-backward links that must be always active. The course author must predefine whether a hyperlink in the guided-tour is to be active or not.

Usually three activities are considered in the development of hypermedia courses: pre-authoring, authoring and reader or learning activities. In a pre-authoring activity, all the hypermedia context of an intended course is designed beforehand. This includes the design of the hyperbase and related guided-tours. In this case, the design of the contents of a hypermedia course can be developed by using hypermedia models or methodologies. In an authoring activity, the hypermedia content of an intended course is effectively developed, considering or not previous designs of hyperbases and related guided-tours. In the reader activity, an apprentice can navigate through the guided-tours of the course trying to satisfy the objectives imposed by the course author. Both the authoring and the reader activity can be supported by academic or commercial hypermedia systems.

Some tools supporting the pre-authoring activity are reported in the literature (Gaines & Shaw 1997, Moroni & Señas 1997). Such a tool is presented in this paper. In order to help the author to design the hypermedia content of a course prior to the authoring activity, the APACHE environment offers support to the pre-authoring activities. APACHE is an acronym for Pre-Authoring Environment for Extended Hypermedia Courses. (Fig. 1) shows the whole research context, emphasizing the architecture of the APACHE environment.

Through the SICH tool one can develop a base of hyperbase designs. Through the SPR tool one can develop the base of guided-tours designs based on the hyperbase designs developed with SICH and considering didactic, pedagogic and motivational aspects. In the authoring activity, by using commercial tools such as Quest and ToolBook or specific tools for Internet, the real hyperbase and the real guided-tours of the hypermedia course will be created. The learner, using a hypermedia system as an interface, will be able to navigate freely through the hyperbase nodes or follow the trails of hyperbase nodes indicated by the guided-tours. In the latter case, the learner can be coached by the system in a non-intrusive way.

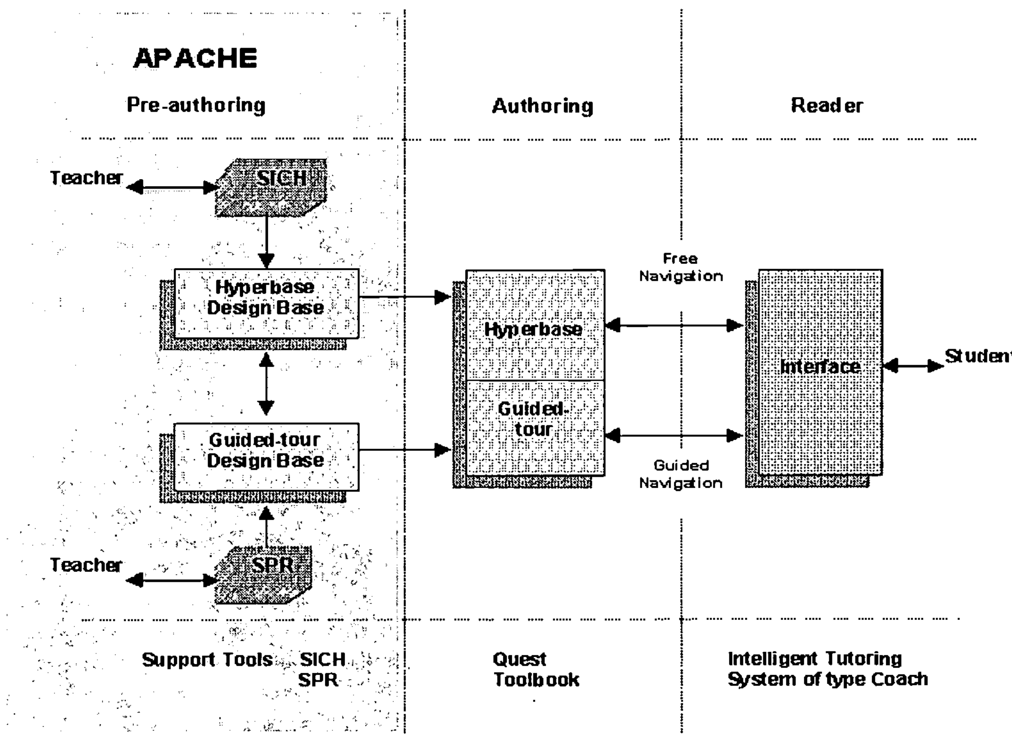

Figure 1: Research context and the APACHE environment.

Pre-authoring Tools

The pre-authoring tools help design and model the hiperbase and related guided-tours. In the design of a hyperbase, the hypermedia knowledge domain is modeled. In the design of guided-tours, a sequence of concepts taken from the hyperbase is modeled in a didactically effective way by the teacher. Next the two pre-authoring tools offered by the APACHE environment, namely SICH and SPR, will be presented.

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SICH Tool

SICH (acronym for Hypermedia Course Construction Tool) offers support to the author in the design of hypermedia knowledge domains or hyperbases. The underlying model, called Daphne (Kawasaki 1996), incorporates both concept maps and information mapping techniques in a harmonic way. The goal is to supply the teacher with effective means to design the hypermedia content of the course, according to the objectives and the methods borrowed from pedagogic techniques used for designing courses for traditional classes.

SICH is composed of a manager for hypermedia courses and four auxiliary editors, as prescribed in the Daphne Methodology: editor for description of the course, concept map editor, information map editor and editor for direct access structures. The manager for hypermedia courses allows doing the following tasks: creating, opening, deleting and renaming a course. Each course will be the root of a specific file directory. From the manager of hypermedia courses one can have access to the editors description of the course, concept map, information map and direct access structures.

Through the editor for description of the course, one can identify in a concise form the whole course, defining the area of interest of the course and its extent. Next, one can define the general objective, writing in a simple sentence what is intended that the apprentice must know after completing the course. The specific objectives and sub-objectives in the cognitive, affective and corporal levels must be also defined.

The concept map is an educational tool of great versatility (Jonassen & Marra 1995, McAleese 1990, Novak & Gowin 1984). The use of the concept map technique allows structuring the knowledge domain of a hypermedia course in a graphic form. This technique has been successfully used as a simple and explicit modeling of educational software (Kawasaki 1996, Moroni & Señas 1997). In the process of construction of concept maps, one can define the group of information that should compose the course, considering that learners may bring a degree of previous knowledge on the subject.

The concept map editor helps the teacher build a specific concept map for a given target subject. (Fig. 2) illustrates the four types of nodes used in a concept map. The creation of a node is accomplished through the corresponding buttons Initial, Middle, Final and Context. An initial node corresponds to the name of the current concept map. A middle node corresponds to intermediary concepts. Final nodes correspond to nodes without any relation to child nodes. Finally, context nodes will indicate other concept maps, facilitating the nested or hierarchical construction of concept maps. The initial, middle and final nodes will directly indicate information maps. In (Fig. 3), a graphical interface shows an example of a concept map elaborated by the concept map editor.

Figure 2: Four types of nodes in a concept map.

The information map editor helps the teacher to structure the nodes of a concept map through the information mapping technique. Information maps provide a high degree of modularization for the instructional material. They help organize, store and present information. This process consists of dividing the target information into more detailed pieces of information called blocks and, in more general way, to obtain an overall understanding of the subject, called maps. Blocks of information represent the smallest portion of information that can be individually accessed. When these blocks are organized in larger and related structures, they form information maps.

According to Horn, all basic information can be classified in seven types of information maps (Horn 1989): Concept, Structure, Procedure, Fact, Process, Classification and Principle. Each one of these types consists of a group of two or more blocks of information referring to a certain topic. The following are examples of types of blocks: definition, introduction, formula, example, remark, etc. In the interface for building information maps, the inner circle represents a topic, whose content corresponds to an initial, middle or final node taken from a concept map. In (Fig. 4), the graphical interface shows an example of a concept map topic, namely the initial node of the concept map illustrated in (Fig. 3), with four information maps, each one with its respective blocks.

Finally, the interface of the direct access structure editor provides functions for defining glossaries and bibliographies. In this case, the teacher can register specific words and their respective meanings related to the target domain or subject. He can also register the authors and respective data of publications. The lists of words or bibliographic references are alphabetically ordered, facilitating the search during the edition task. The information defined through this editor will provide a course with additional resources for the learner. For instance, when navigating through a hypermedia course, the learner will be able to access the meaning of a word belonging to the course glossary directly.

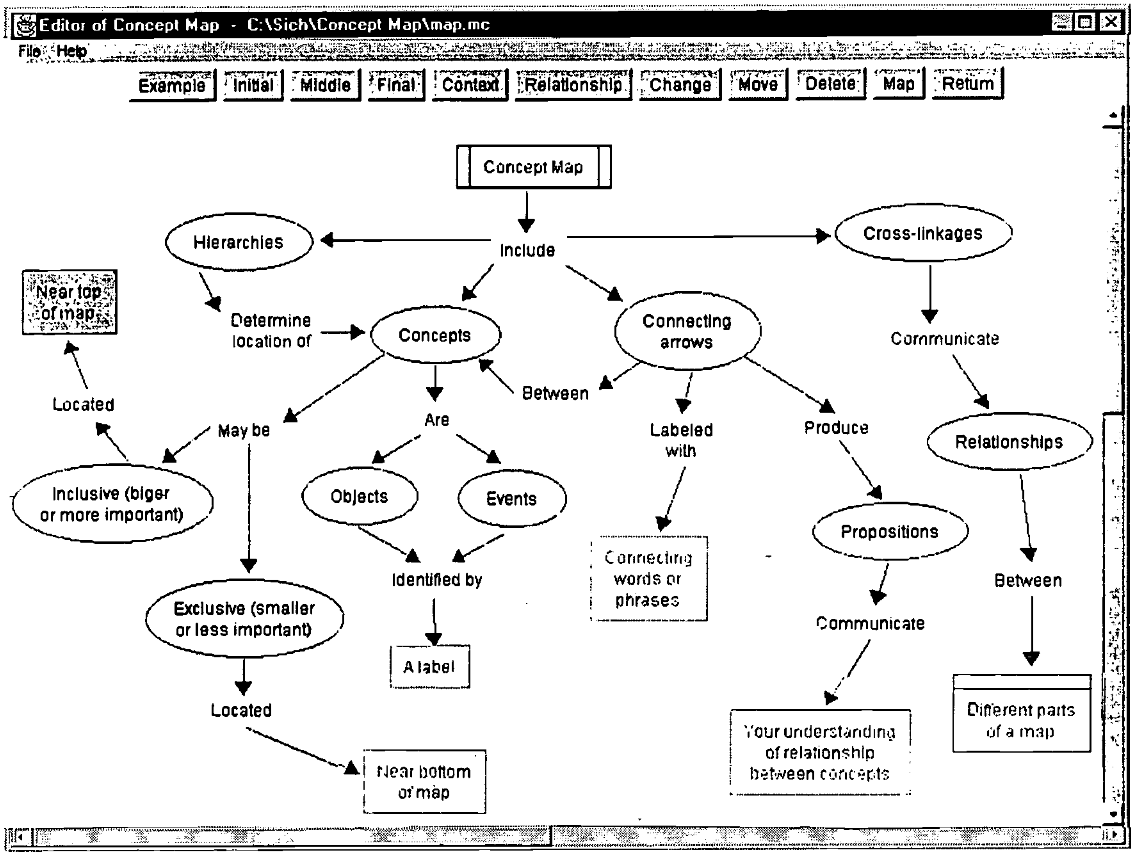

Figure 3: Graphical interface illustrating the construction of a concept map.

SICH is implemented in the programming language Java, an object-oriented language that executes independently of the platform and browser. In the design of the interfaces the essential activities aiming at minimizing cognitive overload, and the correspondent adaptation effort of the author to the interface were taken into account. The operations of saving and opening files are automatic in all the four editors. The tool also facilitates the reuse of the content of a hypermedia course material in other courses.

Related Works

For building concept maps in hierarchical levels, there are two main tools in the literature: JMap (Gaines & Shaw 1997) and MCH (Moroni & Señas 1997). SICH is also a tool for building hierarchical concept maps. JMap presents a diagrammatic notation with only three kinds of nodes, a not so friendly user interface, and does not allow reusing concept maps in other similar applications. SICH presents a better diagrammatic notation, offering four kinds of nodes. It has a friendlier and highly interactive user interface, offering a strategy of automatically opening and saving files related to a specific course, minimizing both the cognitive overloading and adaptation effort of the author to the interface. SICH also presents a specific editor for developing information maps, not present in JMap, which allows better concept structuring and concept maps reuse.

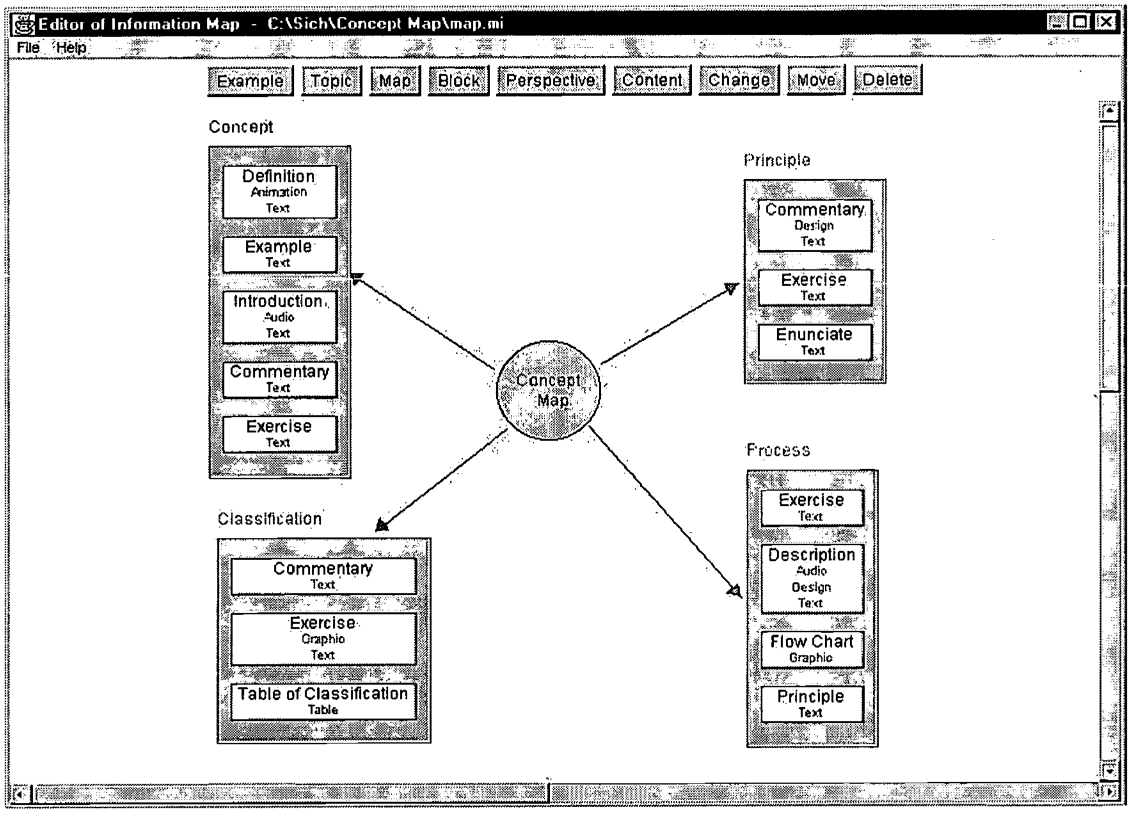

Figure 4: Graphical interface illustrating the construction of a information map.

Both SICH and MCH allow the reuse of concept maps. However, MCH presents a diagrammatic notation with only two kinds of nodes and only a one-to-one relationship between nodes. Besides, the content of each node is inserted directly on the same screen where the nodes are created, making it a confusing operation. The diagrammatic notation of SICH offers two kind of relationship: one-to-one and one-to-many. For inserting the content of a concept node, SICH offers another editor, allowing the developing of information maps.

There are other tools for developing concept maps in the literature (Fisher et al. 1990, Jonassen 1995), all similar to Jmap and MCH, but differing significantly from SICH.

SPR Tool

SPR (acronym for Guided-tours Designing Tool) provides special features for the automated design of guided-tours for hypermedia courses, according to pedagogic criteria imposed by the author, target population and learning objectives.

A hypermedia course is composed of one or more entities, where each entity is a complete set of information about a certain subject. The inner structure of a hypermedia course can be determined through a concept map. In the context of the course, an entity or topic can be classified as belonging to one of the following categories: Body, Complementary Note and Prerequisite. Body is the set of new information that the author intends the learner to acquire. Prerequisite is all knowledge that the learner has to know before doing the course. Complementary Note is all information used for illustration, comparison or reinforcement of the new concepts introduced in the Body part.

The design of a guided-tour takes into account the correspondent hyperbase design. A hypermedia course can have one or more navigational guided-tours. The goal of a guided-tour is to facilitate the learning of the subject. A course guided-tour has a didactic way for presenting de subject, following some pedagogic and motivational scheme.

SPR is an undergoing tool, written in Java, offering a friendly and interactive interface supporting the author of the course in the following tasks:

- Selecting the subjects for each part of the course design and classifying the selected entities as belonging to the Body, Complementary Note or Prerequisite.
- Designing a sequence of pre-defined learning units based on the correspondent hyperbase.
- Designing of limited and programmed access to the hypermedia content related to the topic under the learner's attention.

Conclusions

The process of modeling hypermedia courses should include the pre-authoring task for the design of hiperbases and related guided-tours. The APACHE environment, composed of SICH and SPR tools, will help the planning and development of a hypermedia course. The SICH tool allows a teacher to design educational applications on different knowledge domains, through a friendly and interactive interface. This aspect contributes effectively to the creation of educational hypermedia material. The SPR tool allows the teacher to define guided-tour designs for hypermedia courses based on the correspondent hyperbase. Finally, once APACHE is implemented in Java, it can be used for designing hypermedia courses through the WWW.

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World Wide Web Based Simulations for Teaching Biology.

Jeffrey Bell, Department of Biology, California State University, Chico, United States, jbell@csuchico.edu

Abstract: The Biology Labs On-Line Project is an attempt to create simulations of important biology experiments that students normally can not perform in typical undergraduate laboratories. All of the simulations are designed so that the student has the flexibility to design and interpret their own experiments. The programs generate large amounts of data and are fast enough for students to do multiple experiments. The simulations are all written in Java and are accessed over the World Wide Web. Ten of the simulations, covering the topics of evolution, Mendelian genetics, protein translation, human population demography, protein structure-function, human genetics, mitochondrial electron transport, enzyme kinetics, cardiovascular physiology and photosynthesis will be ready by the summer of 1999, with five more planned for the summer of 2000.

Introduction

The Biology Labs On-Line Project is a component of the California State University System (CSU) Integrated Technology Strategy (ITS), which calls for anywhere, anytime access to information. The project initially brought together biologists from throughout the CSU system and the CSU Center for Distributed Learning (CDL) to explore ways to use technology to improve learning in introductory biology laboratories. Later, multimedia developers from Addison Wesley Longman were added to the development team. A major goal of the collaboration was to allow students to learn as biologists do, *i.e.*, by actively designing experiments and interpreting their results. Another goal was to extend student learning opportunities by creating simulations of experiments that they might not normally do because of expensive and/or inaccessible lab equipment, lack of field opportunities, time constraints, complexity, danger, or ethical problems. Eliminating the time constraints of the traditional experiment and two or three hour laboratory period gives students the opportunity to design and interpret experiments, learn from their mistakes, and to revise and redo their experiments just like real scientists. The simulations are not designed to replace the traditional "wet labs" found in the normal biology course, but rather are designed to extend the laboratory experience to subjects and experiments that can not normally be done, or not done enough, in a traditional laboratory. The simulations are also *not* multi-media presentations, stand-alone tutorials or on-line courses.

The project has produced seven different educational simulations covering the subjects of evolution, Mendelian genetics, protein translation, human population demography, protein structure-function, human genetics, and mitochondrial electron transport. Current projects in progress and due to be finished by the summer of 1999 will simulate enzyme kinetics, cardiovascular physiology and photosynthesis. While each of the simulations is unique, all of them share many common interface elements and functions. All of the simulations have been designed so that the student can carry out many different experiments, allowing the student to design and interpret their own experiments. The flexibility of the programs make well designed exercises an important part of each laboratory. However, while sample exercises will be included with each lab, instructors can easily design their own exercises to meet the needs of their students.

The simulations have all been created in the Java programming language, so that they can be easily accessed over the web using any standard browser. This solves the problem of widely disseminating the applications, a common problem with most educational software. The Java application provides the user interface where students set the starting parameters for their experiment and get graphical feedback on their current settings. In some of the simulations the Java program also calculates the results, while in others the input parameters are passed back to the server, where the real calculations take place. When the server is done it sends the results back to the Java application, which presents the results to the student.

The downside of using Java is that only individuals and schools with fairly new computers and software (Netscape 3 or better, etc.) and an internet connection can use the software. Another disadvantage of using Java is the inability of Java programs to save to disk or print. This limitation has been overcome through the use of a notebook that can be exported to a web page. All of the data tables, such as numbers of different types of progeny, or results of statistical calculations, can be imported directly into the notebook. After typing in their comments the student can export the notebook to a web page for printing, or to email to themselves or an instructor. The web page is temporarily stored on the server. Graphical images such as graphs and charts produced by some of the programs are also exportable to the notebook, where they can then be printed.

All of the programs share some common user interface elements, including a title bar with links to an introduction to the lab, help, sample assignments, the notebook, etc. While there is much diversity in how the different labs operate, most of them start in an input mode where the student designs their experiment by adjusting different parameters. After designing the experiment the student runs the simulation. The program calculates the results of the experiment, usually in a minute or less, and then presents the results in the output mode. In this mode there is a tabbed interface where the student chooses which type of output they wish to view, a table of the data, a graph, the input values, etc. After analyzing their results they can import them into the notebook and then go back to the input mode to design another experiment. This ability to quickly go back and forth between the design of an experiment and the results is one of the powerful advantages of a simulation approach to teaching science.

Seven of the programs are currently available for beta testing and all ten should be finished by the summer of 1999. Descriptions of each of the labs can be found below. Current plans call for a $19.95 fee for access to all ten of the simulations and a lab manual with printed instructions and sample assignments. The fee is necessary to support the servers and for maintenance of the various programs as operating systems and computers change. . The option of selling access to individual labs is also being considered. Below is a fairly complete description of EvolveIT along with brief descriptions of the other simulations However, the best way to learn about these simulations is to go to the CDL site, http://www.cdl.edu/html/biology.html, and try out some of the five simulations currently available there.

EvolutionLab

Although evolution is the unifying theme of the biological sciences, it is perhaps one of the most misunderstood and difficult concepts to convey in a laboratory setting. The study of evolution is especially suited to computer simulations because evolution normally occurs over very long time intervals, large data sets are usually needed to understand it, and there are usually a number of important parameters that are difficult to control in real experiments. EvolveIT (http://www.cdl.edu/EvolveIT), is a web based, interactive computer simulation designed to teach the basic concepts of natural selection and to convey the importance of time in the evolutionary process.

Students using EvolveIT observe evolutionary changes in bird beak morphology in hypothetical populations of birds isolated on two islands. In the simulation students can set the annual rainfall on island(s) containing finch populations, and then observe the effect of this environment on the evolution of the finch's beaks. Students may also change several other properties of the bird populations, such as initial mean beak size, beak size variability, beak size heritability and mean clutch size, to determine their effect on beak evolution.

To help students clearly see the effects of changes in the different variables, the simulation uses two islands with independent and isolated populations. A student can either directly compare two different sets of conditions, or do a duplicate run where both populations have identical starting conditions. As many students will also be unfamiliar with some of the variables, the program gives extensive feedback on what is being changed with each alteration of one of the initial variables. For instance, when the slider for mean beak size is moved to the right a picture of a finch head shows the finch beak growing larger, or when variability is increased a graph of the current distribution of beak sizes spreads out.

The program creates several hundred different virtual "birds" using the initial parameters entered by the student. These birds then go through a round of natural selection where each bird's probability of survival is a function of the seed distribution (determined by the setting for rainfall) and that bird's beak size. After the selection step the surviving birds are randomly mated to one another. They then produce offspring based on the values for heritability and variability entered by the student. This new population of birds becomes the starting population for the next year. This repeats for each year of the simulation. Because of the random selection and mating each simulation run is unique and will produce a different result than any other run, even one that starts with exactly the same starting parameters. The program produces several different outputs: a scrolling table with the mean beak size, the variability and the population size for every year of the simulation, for both populations; a series of histograms showing what proportion of birds of different beak sizes survived, for each year of the simulation; a plot of the mean beak size versus time for both populations; and a plot of the population size versus time for both populations. The final output is a table with the initial values for the simulation.

The student can rerun the simulation with the same initial values, revise the experiment, or start over with the default values and design a new experiment. Students can study the effects of different amounts of rainfall on the evolution of beak size to get a feel for how natural selection works. They should be able to determine that large beaks are favored in low rainfall, the optimum beak size for different amounts of rainfall, the effect of varying the severity of the selection, and the importance of the environment in determining the direction of selection. Similar experiments can be done in which only population variability or beak size heritability is manipulated to study how these parameters affect beak evolution. Changes in island size affect the carrying capacity of the island and allow the student to investigate the stochastic effects that can result from small population size. Variations in clutch size permit the student to investigate the consequences of different fecundities on the capacity of different species to evolve. Some aspects of population dynamics can also be investigated using this parameter (rate of exponential growth, boom bust population cycles, etc.)

While the simulation is based on Darwin's finches, changes in the species variables such as mean beak size, variability, heritability and clutch size create virtual species that can have properties similar to many other wild species. Students can investigate the parameters that are more likely to lead to the extinction of endangered species, see why some species might evolve faster than others, and examine many other facets of evolution. The program generates large data sets, one run can produce 600 data points, so students can learn how to analyze and interpret large amounts of data, unlike the situation in a typical lab. The great flexibility of the program should allow individual instructors to tailor student assignments to their particular preferences and provide students with a real opportunity to design their own experiments. Actively engaging students in exploring and studying evolution through this simulation will provide another avenue for students to learn about evolution in addition to the traditional text and lecture explanations.

Virtual Fly Lab

Two genetics labs are currently planned. One is a simulation of classical fruit fly genetics while the other one lets the student study human genetics by analyzing pedigrees. The Virtual Fly Lab (http://www.cdl.edu/Flylab) simulation is an update to the Virtual Fly Lab originally created by Bob Desharnais. In the Virtual Fly Lab students design their own fruit flies by choosing from many different possible phenotypes for characteristics such as eye color, wing shape, body color, etc. They then mate their flies and analyze the progeny to determine the rules of inheritance for different traits. Each experiment is unique and students can have up to 10,000 progeny produced from one mating. Offspring can also be mated so a wide range of different experiments are possible. There are 29 different traits that can be studied in isolation or in various combinations so the number of possible experiments is in the millions. The traits are all represented graphically so the student can observe the phenotypes directly. For instance, if the student selects the white eye mutation for the female parent their picture of the female parent will change to have white eyes. After the mating they will get a picture of the different progeny, along with numbers beside each picture to indicate the number of progeny of that type (number of females with white eyes, females with red eyes, etc.) The program includes a Chi Square calculator for doing statistical tests of the students hypotheses, and a notebook for recording results, observations, hypotheses and conclusions. Students can import the numerical results from their crosses and statistical tests directly into the notebook.

Using this program students can discover or study most of the important principles of Mendelian genetics, including dominant and recessive alleles, sex-linkage, lethal alleles, independent assortment, epistasis, linkage, gene order, linkage groups, and linkage maps. More importantly, students can discover these principles by doing the same sort of experiments as the original researchers, only much faster. The program is appropriate for a wide range of biology courses as the assignment determines the level of difficulty. Students can do statistical tests, but this is not required. Students can do complicated crosses with multiple traits, or simple crosses with only one trait at a time. If a student is confused by a complicated cross, they can always do some additional simpler crosses to try to figure out what is going on. They can also do additional crosses with the progeny from their crosses, and their progeny, etc. This ability to devise their own experiments and try many different permutations is a major strength of the FlyLab.

PedigreeLab

PedigreeLab (http://caldera.calstatela.edu/PedigreeLab) generates a hundred pedigrees for several different genetic diseases. The student can examine the pedigrees to determine the inheritance pattern of the particular disease. In addition, the student can examine various molecular markers and determine whether they are linked to the genetic disease. Students can use the molecular markers to map the disease gene to a particular chromosome or to a region of the chromosome. This is a key process in the current search for human genetic disease genes and is normally very difficult to explain to students. The program keeps track of the results from each pedigree they use and can determine the statistical significance of their results. Having them actually go through the process of mapping a human gene should significantly improve their learning of these difficult concepts.

TranslationLab

So far, the Biolabs project has produced two molecular biology simulations. The first, TranslateIT, http://www.cdl.edu/TranslateIT, simulates some of the original experiments used to crack the genetic code, one of the key discoveries in molecular biology. These experiments rely on radioactive materials and difficult to produce RNA templates so they can't be done in the normal biology lab. Students design and create simple RNA molecules in the simulation that they then translate in a virtual *in vitro* translation mix. The program shows a simple animation of the techniques that would be used to analyze the products of the translation and then gives them the amino acid sequence of any proteins produced in their experiment. The student must logically analyze the results of multiple experiments to deduce the properties of the genetic code, just as the original researchers did, only with the advantage of being able to do experiments in minutes that normally take months to carry out. Various properties of the code that can be determined using this simulation are the triplet nature of the code, that the code is non-overlapping, codon assignments for particular amino acids, and the existence and identity of stop codons.

HemoglobinLab

In the second molecular biology simulation, the HemoglobinLab, http://www.cdl.edu/HemoglobinLab, students investigate various aspects of the molecular biology of hemoglobin, using case studies. The goal is for the student to learn how changes in the nucleotide sequence of a gene *may* effect the protein sequence, which *may* effect the structure of the protein, which *may* effect the function of the protein, which *may* effect the properties of the cell, which *may* in turn effect the physiology of the individual. Students choose a case by selecting a patient from a pull down menu with a list of over a dozen patients. For each case the students can examine the doctors notes about the symptoms and medical history of the patient, examine the color of a vial of the patients blood, examine the blood under a microscope to see if there are changes in the red blood cells, run a sample of the blood on an electrophoresis gel to determine if there are physical changes in the globin protein, and, finally, the student can determine the amino acid sequence of the patients globin protein. Having determined the sequence of the protein the student can go to the DNA sequence editor and try to alter the

DNA sequence of the normal gene to see what type of DNA mutation would cause the changes found in the patient they are examining. The patients have a variety of mutations in the globin gene ranging from simple point mutations that change one amino acid, such as in sickle cell anemia, to deletions and insertions causing frameshifts, such as some of the thallasemias. The mutations cause many different patient phenotypes, such as anemia, brown blood, polycythemia (too many red blood cells), and purple skin color.

DemographyLab

The Demography Lab, http://caldera.calstatela.edu/DemoLab, models human population growth in several different countries around the world. Students can use this lab to investigate how differences in population size, age-structure, and age-specific fertility and mortality rates affect human population growth. Default values for seven countries have been incorporated into the program to allow comparisons between nations with very different demographics, such as Japan and Nigeria. In addition, students can change any of the parameters to create their own experiments. The proportion of males and females in each five year age group, the total population size, the mortality rate for males and females in each five year age group and the birth rate per female in each five year age group can all be set by the student using a simple graphical interface. After running the simulation for 100, 200 or 300 years, students get summary statistics for the population at the end of the time interval, such as life expectancy, birth rate, population growth rate, etc. They can view a line graph of population numbers over the course of their experiment, see a graphical representation of the population structure for every five years of the experiment, or examine the number of males and females in each age group for each five year period. Using the program a variety of demographic phenomena can be demonstrated, such as exponential growth and decline, stable age structure, zero population growth, demographic momentum, dependency ratios, sex ratios and marriage squeezes.

MitochondriaLab

Three biochemistry and cell biology labs currently in development are MitochondriaLab, EnzymeLab, and LeafLab. MitochondriaLab, http://www.cdl.edu/MitochondriaLab, simulates electron transport, proton gradients and oxidative phosphorylation in mitochondria. Students recreate the classic experiments that established the chemiosmotic theory as the mechanism for energy production in the cell. They add various substrates and inhibitors to their virtual mitochondrial extracts and then measure the consumption of oxygen over time. From their results they can work out some of the steps in the pathway and the mechanism by which the chemical energy is converted into ATP molecules.

EnzymeLab

In EnzymeLab students will study the enzyme kinetics by varying quantities of substrates, cofactors and inhibitors and then measuring reaction rates. They will also be able to vary temperature and pH to determine their effects on a typical enzyme catalyzed reaction.

LeafLab

The LeafLab will simulate the photosynthetic reactions in leaves. Students will vary wavelength and intensity of light, CO_2 and oxygen concentrations, temperature, and type of leaf and then measure the consumption of CO_2 in their simulated leaves.

CardioLab

The tenth lab currently under development is CardioLab. This lab will simulate the cardiovascular function. Students will be able to inject various hormones, remove or add blood or plasma, alter diet and exercise, and stress their virtual subjects and then can track various physiological responses such as heart rate, pressure, and blood flow over time. Students will also be able to do experiments on virtual patients with various health problems such as obesity, heart disease, atherosclerosis, etc. Student experiments should lead to a greater understanding of hormone action, positive and negative feedback loops, homeostasis, and physiological pathways. Understanding this physiological cycle is obviously of great importance to the students and will also teach them many important physiological concepts.

Assessment

The precursor to all of these labs is the original virtual Fly Lab. This simulation of fruit fly genetics is now used in biology classes all over the world, and has created so much demand on the server hosting the program that there are now five different mirror servers. The Virtual Fly Lab, EvolveIT and TranslateIT have been field tested in an upper division genetics course with encouraging results. 98% of the students in this course considered their Virtual Fly assignments useful in learning genetics, 83% found EvolveIt to be useful and 93% found TranslateIt useful. Some sample comments from the students are:

"Excellent 3 part demonstration of Mendelian genetics - each lesson built on the previous one - excellent practice for the tests. Also includes repetition of important concepts (X linkage, etc.)"

"Liked best - actually enjoyed! (what a concept) Virtual Fly I, II, and III. These were great fun to puzzle out - someone's going to hate me for saying this"

"TranslateIt was enjoyable because it requires the student to investigate and solve the problem."

"Virtual Fly and TranslateIt were the assignments I got the most out of. I liked the way it made you systematically think to solve the problems."

"I liked the Virtual fly and EvolveIt activities because they allowed you to do some investigation on your own and they made you think about what was really happening, which made you understand the material better."

There were only a few negative comments, usually having to do with the difficulty of getting on-line and using the programs. Students who are uncomfortable with computers are at a disadvantage when using these simulations and special care must be taken to make sure they get the most out of the simulations. The only other negative comment was, "I liked TranslateIt the least because it made my head hurt." While this is unfortunate, if the BioLabs project can produce more simulations that cause some students heads to hurt, then the project will be producing simulations that change, for the better, the way biology is taught.

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Facilitating Virtual Learning Teams in Online Learning Environments

Lara Luetkehans, Ph.D.
Northern Illinois University
DeKalb, IL, USA
luetke@niu.edu

Margaret L. Bailey, Ph.D.
Northern Illinois University
DeKalb, IL, USA
pbailey@niu.edu

The Challenge of Virtual Learning Teams

Exceedingly, today's educators are expected to adapt teaching and facilitation techniques to new and emerging delivery systems. The number of educational courses and training programs migrating to the World-Wide-Web, the Internet, and corporate intranets is astounding (see Bassi, Benson, and Cheney 1996). For most educators, the migration to computer-mediated distance education does not come easily. Although at first glance, it seems that traditional teaching methods such as presentation, discussion, and team-based learning can be easily adapted to on-line delivery systems, in reality research is showing that teaching and learning in on-line environments is very different from face-to-face instruction (Luetkehans 1998; Sherry 1996). Of particular interest to educators is the effective facilitation of collaborative team learning in on-line environments.

From a student perspective, participating in a virtual learning team (VLT) is a new, and perhaps frightening, experience. Mary Lou Crouch and Virginia Montecino (1997) note a phenomenon experienced by on-line learners called "cyberstress." The asynchronous nature of many on-line courses and communication tools, and the perceived distance between learners and other team members contributes to fears of contributions and assignments left unnoticed and "lost in cyberspace." Students have not developed sufficient experiences for dealing with delayed communications, the generative nature of on-line learning, nor the ability to express themselves effectively to team members through written communication.

The purpose of this paper is to present tips for educators who would like to successfully integrate and facilitate virtual learning teams within their on-line courses. The techniques are grounded in current research and the theoretical foundations of systems theory and group dynamics. Tips emphasize facilitation of virtual learning teams assembled for the purpose of formal education who are supported by computer-mediated communication tools.

Critical Elements of Virtual Team Learning

Task or Problem

A team is defined as "a number of persons associated in some joint action" (Webster's Unabridged Dictionary 1992). However, all virtual teams are not created equal. The VLT process is affected by the type of task or problem it is given (Straus and McGrath 1994). As with other instructional strategies, virtual learning team activities can be classified by learning domain (Bannan and Milheim 1997). Specifically, team activities can be classified as those designed for a.) motivation or attitude development, b.) problem-solving, c.) skill building, and d.) knowledge construction. The instructional goal and the type of team activity has a direct impact on how the team members explore and define team objectives, plan a course of action, and their perceptions of success. A clearly communicated instructional goal and desired performance outcomes of the team are essential no matter the delivery system.

Team Dynamics and Interaction

As with face-to-face teams, VLTs are governed, in part, by the dynamics of group communication. Group dynamics is concerned with both the productive (task) communication of members as well as the development of roles and relationships among team members (maintenance). All teams, whether on-line or face-to-face, will develop and enforce group norms (e.g., acceptable and unacceptable communicative behaviors) and methods for leading, stimulating, rewarding and punishing team member contributions. Often, on-line educators overlook these elements of VLT interaction because they are focused solely on content (task) learning and interaction. Taking a more systems view of team interactions may help avoid so-called "internet pitfalls" (Boettcher 1997) of on-line communication.

Team Member Roles

The greatest value of team learning may also be its greatest challenge. That is, a group is made up people with a diversity of talents, strengths and experiences. This brings with it the foundation for stimulating discussion, creativity, and effective problem solving. However, it also means that each member of the team comes into it with established habits, learning styles, and preferred team roles. Most of the current literature agrees that effective teams are able to represent a balance between task roles (goal accomplishment) and maintenance roles (process satisfaction and efficiency). Task roles and maintenance roles take on new character in on-line environments. Task roles dominate and are performed both on-line and off-line. Maintenance roles, although critical to team connectivity, may not be performed until conflict arises or inefficiency is felt. The maintenance role of leading consensus is more difficult to achieve on-line (Harasim 1993).

Mediated Communication

Two factors differentiate a VLT from a face-to-face team: 1.) team members who are "out of sight" and unless a face-to-face introduction has occurred, who are based on an impression established by text and description, and 2.) a reliance on connections between team members made through electronic or computer-mediated technology. Both facilitators and team members must rely on virtual (as opposed to tangible, touchable) connections in order to achieve goals. The result may be a perceived loss of control and security for both the facilitator and the team member. Members fear a loss of productivity if that connection is not reliable or effective.

Facilitation

To facilitate is "to free from difficulties or obstacles; to make easier; to aid; to assist" (Bailey 1996). VLTs are generally facilitated both from the outside (by the educator) and within (by team members). The role of the outside facilitator (the educator) in on-line environments is changed from that of face-to-face instruction. The role of the outside facilitator, because of the nature of VLTs, entails 1.) ensuring that no barriers (technical, informational or motivational) exist to team learning, 2.) ensuring essential elements for learning are accessible (such as interaction, task information, and feedback), and 3.) aiding team members in times of conflict or confusion.

Ten Techniques for Virtual Learning Team Facilitators

Tips for Facilitating Motivation and Efficacy

Tip #1 - Help team members manage "cyberstress"

Help learners overcome initial stress by sending a detailed advance e-mail at the onset of the team activity. Include a welcome, a description of the team goals and desired outcomes, and tips on being a successful team member in an on-line course. Ask members to contribute personal information about themselves as a first communication to the VLT. Ask them to include their background, familiarity with the task/problem, and talents/contributions they will be bringing to the team. As the course continues, manage the stress resulting from delayed communications by sending "receipt" messages. A receipt message is a short feedback message indicating that, although you cannot immediately respond to the learner's message or review the assignment, you received it. Encourage team members to do the same. Help teams establish ground rules for frequency of checking computer-mediated communications.

Tip #2 - Plan frequent e-mail prompts to help team members overcome procrastination

It is important to help team members sustain participation. "The major reason for disappearance has to do with a student's feelings of not being connected" (Crouch and Montecino 1997). E-mail reminders are useful in helping to keep the team activity in the forefront of learner's thoughts. E-mails should not be nagging, but serve as friendly reminders to log-on to the site, ask if assistance is required or for reports on team progress.

Tips for Facilitating Problem-Solving

VLT activities for problem solving typically require methods that encourage both creativity and decision-making. Activities which integrate knowledge and skill sets with real problems and contexts may include case scenarios, simulations, team research and reporting, negotiation, and decision making. The facilitator of problem solving must be skilled at supporting the phases of problem solving and in helping teams achieve consensus.

Tip #3 – Provide a variety of tools to support the different phases of problem solving

Provide each team an exclusive area on the course website for posting team resources and strawman solutions. Because problem solving requires both exploration and consensus, VLTs should have the ability to access and post hypertext resources for information searching and sharing, as well as tools to develop and debate solutions. Provide a combination of tools for different stages of problem solving. If the problem or case study will take several sessions to solve, teams will benefit from access to an asynchronous tool that can be used to keep the history of the team's discussions and negotiations. If the problem can be resolved in a single sitting, a synchronous tool for discussing and defending individual perspectives or even voting can be useful. Asynchronous problem solving is best supplemented with a synchronous tool during stages of negotiation and decision making.

Tip #4 – Assist team members when they struggle with achieving consensus

Teams often appreciate the intervention of a neutral facilitator when it comes time to make critical decisions or select among alternatives. Explore methods for polling team members, and for conducting on-line voting. The summary is an effective tool for leading to consensus. Often team members are too busy looking forward to see where they have been. Review team progress, and summarize it as you see it. For example, "I see you are developing two pretty distinct alternatives. The first appears to focus on the navigation needs of the learner. The second focuses on the simplicity of design. Which do you feel are priority given the goal of immediate access?"

Tips for Facilitating Skill Building

Activities that allow for the development of skills may include small group projects and expert modeling. The facilitator of skill development must be expert at designing authentic projects, offering timely and meaningful feedback, modeling, and leading effective reflection and debriefs of skill activities.

Tip #5 - Assemble teams strategically based on task and talent

In online environments, larger groups are less productive and have more difficulty arriving at consensus, so consider 3-4 members per team as a target (Dennis & Gallupe 1993). If possible, teams can be balanced on talent and experience (e.g., with HTML) so that an "expert" in the team is able to provide modeling of the skills and scaffolding for other team members. Assess the skills targeted for development. Design tasks around the targeted skills, and communicate them through clearly stated objectives. Focus tasks on the development of a single competency area, or a small number of skills.

Tip #6 - Provide timely and meaningful feedback

Skill building depends on frequent practice and feedback. The facilitator can use semi-private and private communications for feedback. Semi-private communications can be established by providing "exclusive" threaded discussions, chat rooms or Listservs accessible only by team members. Individual feedback should be conducted via e-mail. The facilitator should plan and use process checks as part of project activities. A process check is a planned "check point" for communication, reporting, and questioning on a project's progress. Synchronous tools are effective for conducting process checks. When the activity is complete, conduct an asynchronous debrief discussion. The facilitator should use questioning techniques that stimulate reflection and processing. Modeling difficult tasks and behaviors is another form of feedback, allowing students to compare their outcomes to a benchmark or standard. Use hyperlinks to show learners examples of completed projects, forms, or reports on the course website or in threaded discussion.

Tips for Facilitating Knowledge Construction

Activities that develop new concepts, contexts, and meaning may include reading, information searching and sharing, discussion, inquiry, and reflection. The facilitator of knowledge construction must be skilled at scaffolding discussion, and encouraging exploration and elaboration.

Tip # 7 - Scaffold topical discussions using a threaded discussion (asynchronous) tool

An effective scaffolded discussion involves a.) providing an initial structure and b.) facilitating concept construction through questioning. The structure can be minimal. If the discussion topic is new to learners, post a topic name along with 1-2 open-ended questions to initiate thinking. This allows students to construct the concepts and detail. Facilitators should avoid dominating discussions by using relay questioning techniques and only participating when necessary. To encourage continued contributions, reward participants' thoughtful responses with short affirmations. Finally, when discussion objectives have been met, the facilitator can quickly "point to" the learning with a brief summary. Summaries provide both rewards and reinforcement.

Tip #8 - Encourage elaboration through questioning and hypertext linking

As in face-to-face facilitation, effective questioning techniques are useful to encourage elaboration. Use open-ended questions to stimulate a response that builds on prior concepts. For example, "Jack, you indicated 'a survey as one ways to gather information for a needs assessment.' What other techniques could you employ?" Hyperlinks to additional information or expertise can also be used for stimulating elaboration. Many Internet communication tools accept HTML links within the message body. The facilitator should model the use of hypertext in her responses. In addition, e-mail links can be included as a way to access outside experts willing to participate in discussions or private e-mail exchanges.

Tips for Resolving Conflict

Teams will rely on the facilitator to intervene in times of dysfunction. It is the facilitator's primary function to remove these obstacles to learning.

Tip #9 – Discourage judgment, criticism and personal attacks

Carefully phrase retributions to comments that are clearly not constructive. For example, "While I realize that we will not always agree with all point of view expressed on this forum, this is a reminder to reflect and build on IDEAS, not judge the PERSON." This typc of conflict can be avoided if teams adopt ground rules that encourage members to suspend judgment and accept diverse views. Post the rules at the beginning of a team activity or on the course website. Monitor the interaction and remind members when a contribution is outside of the accepted rules.

Tip #10 – Intervene to highlight areas of common ground among conflicting team members

Team members will expect the facilitator to intervene when conflicts get personal or unproductive. Start by helping team members see areas within their conflict that they agree upon. For example, "Sara and Tom, you seem to be at a stand still. In reviewing your discussion, it appears that you are both concerned that the end product be visually appealing. Is that correct?" Encourage the use of synchronous tools to resolve heated conflict in a timely fashion. Phone conferences may be more effective than computer-mediated communication to resolve personal conflict.

Drawing on a theoretical framework emergent from constructivism, systems theory and group dynamics, this paper presented ten tips for facilitators of virtual learning teams (VLTs). An on-line facilitator's required skills range from selecting and designing appropriate on-line tasks to assembling teams and removing obstacles to team task and maintenance roles. Of greatest importance is to intervene on any matter that deters a team's technical, informational, or motivational needs. As more courses migrate to computer-mediated environments, on-line facilitation skills will become increasingly critical to educators.

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Awareness and Cooperation Tools for a Simulation-based Learning Environment

Elizabeth Medélez, Gerardo Ayala
Information and Automation Technologies Research Centre, CENTIA
Universidad de las Américas - Puebla, Cholula, México
Tel.(22) 29 26 68
Fax. (22) 29 21 38
ayalasan@mail.udlap.mx

Cleotilde González, Javier Lerch
Center for Interactive Simulations, CIS
Carnegie Mellon University, Pittsburg, PA USA
Tel. (412) 268 62 42
Fax. (412) 268 50 63
conzalez@andrew.cmu.edu

Abstract: In this paper we present the prototype version of MGCoop, a set of CSCW tools developed for Management Game, a simulation-based learning environment developed by the University of Carnegie Mellon. This paper presents the design of CSCW tools that allow the students to plan and establish virtual meetings through the internet, maintaining them aware of their capacities, commitments, availability and activities, in a learning environment. The students can work in a cooperative way, being coordinated using a WYSIWIS workflow environment, and presenting and discussing their points of view in an asynchronous or asynchronous way. We included the results obtained during the analysis from the interaction problems presented by the members of the learning group during their cooperation meetings. Some examples of these tools are presented, which were implemented in JAVA, permitting platform independence.
Keywords: CSCL (Computer Supported Collaborative Learning), Groupware, CSCW (Computer Supported Cooperative Work), JAVA, Workflow, Simulation Based Learning.

Introduction

Currently, learning environments based on the cooperation and the collaboration of students present new alternatives to the teaching-learning process (O'Malley 1995) in educational institutions as well as in organizations. Learning environments, based on technologies of CSCW (Computer Supported Cooperative Work) (Khoshafian & Buckiewicz 1995), allow the training and the collaborative work in companies, increasing their competitiveness. Since1995 research and development projects in educational software have been proposing the adjustment of the concepts of CSCW within a theoretical learning collaborative framework, appearing the area of CSCL (Computer Supported Collaborative Learning) (Ayala & Yano 1998) (Ayala & Yano 1994).

Together with researchers of the University of Carnegie Mellon, and continuing the same research guidelines (Cadiz et al. 1998), in the UDLA-P we have developed a set of CSCW tools for a simulation based learning environment (Medélez 1998). These tools have been designed based on the interaction study of members of learning groups, who need to cooperate and be aware of the activities each one must accomplish and the students that are working in a given moment, supporting in this way their coordination. The activity that the group must accomplish together is the creation of a report that must be presented periodically to a committee. This activity is the one which the students require more coordination and cooperation in Management Game, which is the reference framework of our research project.

Management Game

Management Game was developed in the 50's, with the participation of teachers of the Graduate School of Industrial Administration (GSIA) of the University of Carnegie Mellon. The purpose of this game is to learn by applying knowledge of business administration in a competitive and dynamical simulation environment. A learning environment based on simulation provides a great number of advantages in comparison with the simple analysis of cases of studies or the readings of textbooks. The simulation promotes the competition between several companies, each one of they formed by a group of students (Lerch et al. 1997). This game, already a tradition in the University of Carnegie Mellon, became an international game in 90's, when students of Sweden, Japan and Mexico were included (Lerch et al. 1997). The UDLA-P participated in the game with a group formed by students of the master course in Business Administration and Industrial Engineering. Using this game, the students put in practice their knowledge, competing with students of different parts of the world, living an experience of international training.

In Management Game, the students can play two or more roles in their company (president, counting, investigating of market, responsible for marketing and sales, of production, of operations, of finances, of competitive analysis, strategic planning and of communications). It is very important to assign the roles to the most suitable person, as well as to keep the students aware of (1) the roles that each student plays, (2) her/his commitments, (3) the assigned tasks and (4) their schedule and deadlines. After some experiences with the learning groups, it was determined that the learning environment required a set of CSCW tools for the coordination and the efficiency of the work in the learning group.

Interaction Requeriments

After some meetings with the students participating in Management Game, we found the following interaction problems in the learning groups, which were affecting their performance and therefore their learning:

a) Meeting Difficulties. Some of the group members already had established commitments in other enviroenments, like companies or other institutions. In occasions, they have to make trips outside the city, which made difficult to plan face to face meetings.

b) Lack of cohesion and awareness of the group. The students presented problems based on the ignorance of who was available and what activity was performing in a given moment, when they required cooperation.

c) Lack of control and follow-up of the workflow. The students presented coordination problems, not knowing exactly to who they have to deliver the results of their task This causes a delay in the accmplishement of the report to be submitted by the group.

d) Lack of awareness about the capacities and commitments. Some groups presented problems in the assignment of roles, since the student playing the role of president was not aware that some peer had a greater capacity or experience in some specific activity within the simulation. There were also awareness problems concerning the assigned tasks and commitments by each student.

e) Heterogeneity and conflict in the decision making. The groups include students of industrial engineering as well as business administration. As a result, the interaction between students presented conflicts due to different points of view.

It was considered that without a cooperative working environment designed for Management Game these problems could not be solved, specially if in a near future it is planned to have more heterogeneous groups from different institutions and, later from different countries.

CSCW Tools for Management Game

In order to propose a solution to the problems mentioned in the previous section, we have designed and developed an environment in JAVA where the students learn by collaborating with their peers through internet while working in Mahnagement Game. These CSCW tools allow the student to:

1) Be aware of the participants who are working in a given moment.

2) Be aware of the activities of each member of the learning group, via an electronic agenda supported by a calendar.

3) Be aware of the tasks already concluded by the members of the learning group, the relationship between these in the context of the common work, as well as of the deadlines of the tasks, via an workflow environment.

4) Clear assignment of the tasks to perform by the members, an agreement of the role assigned to the members play, according to their capacities, via a users manager tool. There is a document manager that includes the concurrence managing, including the access and modification privileges of shared files.

5) A synchronous communication tool between peers (chat), as well as a asynchronous communication tool (e-mail) developed *ad hoc* the needs of the environment.

MGCoop

In order to support awareness, the cooperative work and learning of the students that play with Management Game, we developed MGCoop. MGCoop has been implemented in JAVA. We used the WIMPs (Windows, Icons, Menus, Pointers) interfece concepts (Van Dam 1997) and the classes *AWT* (Abstract Window Toolkit) (Sun Microsystems 1998) and *Swing* (Fowler 1998).
We have organized theMGCoop tools in three groups:

a) Users Manager
b) MGCoop Workflow Environment
c) Communication Tools

Users Manager

The work assignment in a responsible way is a very important aspect that we consider when we designed the environment MGCoop. In this way we could improve the group performance. The users manager module includes tools that keep awareness, communication and coordination, so the students can work in a cooperative way. These tools are referred to the following functions:

a) Assignment of the student's role. Used by the coordinator of the groups in an institution. S/he assigns the role to perform by each student in the virtual company.

b) Consulting and modifying student information. Any student of the group have on line access to the name, role and electronic mail address of her/his peers. The coordinator can modify the assigned role previously to any student when it will be necessary (Fig. 1).

c)Users Directory. Keep aware any student of the group about who is working in the environment in a given moment, as well as the role that it is performing (Fig. 1).

d) Synchronous Communication. A chat tool was specially designed for Management Game. Any student is able to communicate and collaborate with one or more of their peers in real time (Fig. 2)

e) Asynchronous Communication. An email tool was specially designed for Management Game. Any student is able to communicate and collaborate with one or more of their peers at any time.

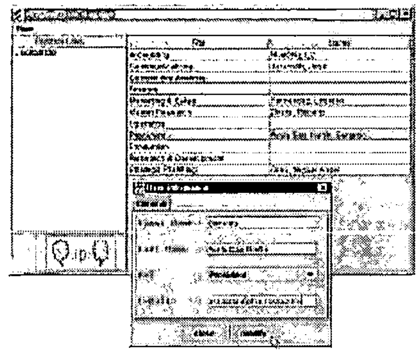

Figure 1: General Information of a user

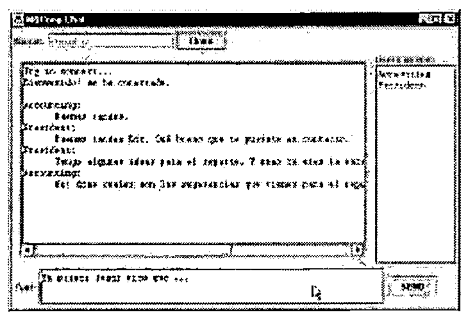

Figure 2: Synchronous conversation between two members

MGCoop Workflow Environment

Within the technology of Groupware, automated workflow systems are environments that permit the control of activities, task assignment and the coordination and cooperation (Khoshafian & Buckiewicz 1995). For MGCoop we have developed a workflow environment based as a WYSIWIS (What You See Is What I See) interface. This tool allows any student to observe in real time the changes and the advance of the report constructed by the group, represented as a sequence of related tasks. It was necessary to study the interactions between the members in order to design the workflow environment.

The students, as members of a virtual company, should present a report to an established executive committee, composed by real executives supporting Management Game. The meetings where the reposrt are prersented are given in three occasions during the development of the game. In the first is made known the strategic plan that the company will follow. In each one of the remaining two a summary of the company operations is presented. Each report consists of a set of related projects. Each one of these projects consists also of a set of tasks to be performed by the members of the learning group.

The characteristics of the MGCoop workflow environment include:

a) Graphic workflow.

The projects and the tasks are represented in an workflow graph (Fig. 3) in which projects or tasks are presented as squares related with others considering their requeriments. Each task or project in the interface are sensitive to the action of the mouse, presenting to the user the relevant information, as name, responsible, requesting, completion date, requeriments and current state. A project indicates the tasks that compose it, and each project has its respective workflow graph representing the tasks implied. Tasks and projects are presented in red color while they have not been ended, and in blue color when they have been accomlished. The environment allows the user to build the workflow graph using the mouse and selecting information related to the tasks or projects

through menus, buttons and text areas.
The president must assign the deadlines of the projects that conform the report, in this way the members of the group will know the completion dates of each one of the projects.

b) Task assignment
The environment automatically provides to the president the suggestion of the most indicated person as responsible for a work, according to the specifications of Management Game.

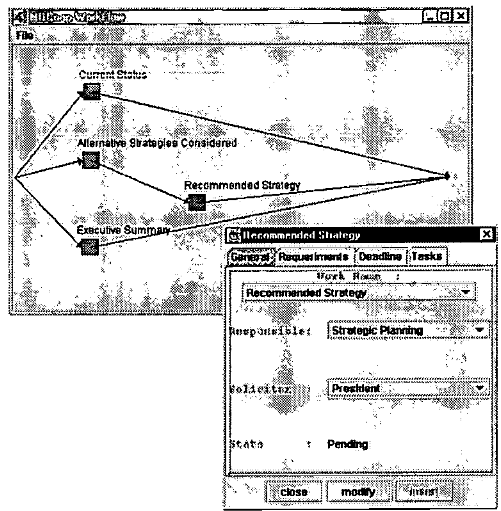

Figure 3: Interface of the Workflow, showing a report composed of 4 projects.

Communication Tools

MGCoop contains tools of chat, electronic mail and agenda electronics designed specifically for Management Game. The possibility of synchronous and asynchronous communication and cooperation permits to solve the problem of the physical meeting difficulty. Through these tools the members of the group will be able to take decisions in group, to solve their different points of view and to plan meetings they will be physical or virtual. The electronics agenda provides necessary information to plan these meetings, the members of the group will be aware of the activities of each one of their peers.

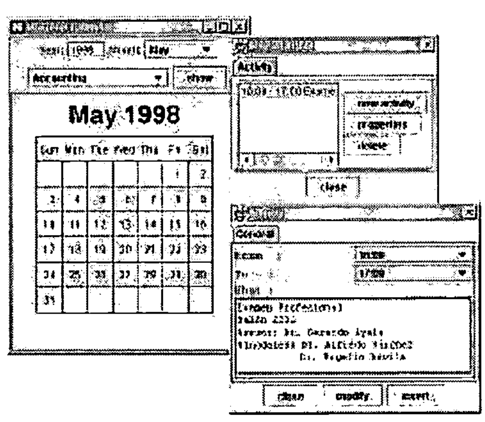

Figure 4: Activities to accomplish by a member of the group

It was necessary to study the way in which the members of the learning group would have to be communicated, in an asynchronous or synchronous way. The asynchronous form that we employ was the electronic mail, and the synchronous way was the "Chat". Both tools were designed in a special way for the users of Management Game due to they were not familiarized with already existing tools. We consider that to use various tools and interfaces for their work can influence negatively their performance.

The chat tool of MGCoop includes the representation of the roles of the users, permitting them to be aware of their commitments. The electronic mail of MGCoop is also very easy use and forms part of the environment. The issued messages can be read from any other email tool, not only by MGCoop.

The environment also provides an electronics agenda that shows the students the calendar of the other peers actvities in a graphic way and sensitive to the action of the mouse. When a day of the specific month is selected, the activities that the selected member has for that day appear (Fig. 4). At any time a student can add a new appointment or activity into her/his personal calendar.

Conclusions

MGCoop is a set of colaborative tools designed for a simulation-based learning environment. These tools were developed as a result of the research in the area of CSCW on the interaction required by the users of Management Game. The developed environment permits the students to plan and establish virtual meetings, and be aware of the capacities, commitments, availability and activities of their peers. Also it allows the cooperative and coordinate work thanks to a workflow environment and the presentation and discussion of their points of view in a synchronous or asynchronous way.

Currently we are working in the development of more classes in JAVA in order to include in MGCoop the interaction through videoconference. MGCoop it is currently in a test period and it will be used in the beginning of the following year when Management Game is going to be played again.

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An Agent-based Life-long Learning Environment for Japanese Language

Gerardo Ayala
Centro de Investigación en Tecnologías de Información y Automatización (CENTIA)
Universidad de las Américas-Puebla
México
ayalasan@mail.udlap.mx

Abstract: The paper presents the design issues of SALLE, a life-long learning environment based on software agents modeled for the social construction and use of Japanese language knowledge. This research proposes the new paradigm of agent based life-long learning environments for Japanese language, based on the idea that the study of a second language, specially the Japanese for western people, is a life-long learning process.

With the development of SALLE (Software Agents for a Life-long Learning Environment in Japanese) we try to determine the real, relevant and truly useful educational material for the study of the Japanese language, also motivating the discovery, use and sharing of knowledge by the learners in a virtual community in the Internet.

Introduction

The concept of life-long learning has become one of the most important topics in computer assisted education. Life-long learning refers to the continuous education that implies the updating of our knowledge in order to be more capable, productive and competitive, adapting ourselves to the dynamic changes in our ever evolving world. Lifelong learning, according to the definition by the European Lifelong Learning Initiative (ELLI) and presented in (Longworth, 96), is:

> "a continuously supportive process which stimulates and empowers individuals to acquire all the knowledge, values, skills and understanding they will require through their lifetimes, and apply them with confidence, creativity and enjoyment in all roles, circumstances and environments."

In a global and internationalized world, lifelong learning has become a necessity for everyone due to the rapid changes in our knowledge based society (Berge, 98a). Lifelong learning environments are needed for the competitive advantage and success of leading-edge companies and universities. In this context, it is clear that the study of a second language is a life-long learning process, since language is dynamic and in constant change.

A learner centered approach (Berge, 98b) has become the actual tendency in educational software for second language learning. From this point of view, the learner has the responsibility of her/his own learning, not the teacher or the tutor. This approach, supported by theories of Constructionism (Resnick, 96), has been promoting the research and development of learning environments, as an alternative to tutoring systems. Nowadays there are two main problems of actual interest in this learner centered approach (Berge, 98b), first we have to determine how to provide access to real, relevant and truly useful educational material; and second, we need to motivate the discovery and use of knowledge by the learner, and make her/him share it with others. We believe that the solution to these problems implies the design and development of a life-long learning environment based on the concept of social construction of knowledge (Barret, 92). For a life-long learning environment the continuous social construction of knowledge should be not a specialized activity, but a way of being in a community, which represents a culture that consists of ideas, beliefs and knowledge shared by its members.

We are considering the World Wide Web as the main source of knowledge and information which contains the real, frequently used, current and popular language patterns, words, expressions and kanji compounds of the written Japanese language, situated in a real context. Since Japanese language changes continuously, specifically in new words adopted from other languages and expressions, the knowledge represented in a life-long learning environment must be updated with the language elements used by the producers of WWW pages in Japanese and by the participating members of the community of Japanese language learners. Our objective is to develop a computer mediated learning environment where the participants can learn using and constructing together a knowledge base representative of the written Japanese language currently and frequently used.

In this paper we introduce SALLE (Software Agents for a Life-long Learning Environment in Japanese). SALLE is a multiagent learning environment where software agents cooperate and assist their learners, providing a learning environment based on the coordinated social construction of a knowledge base as a representation of the current use of the Japanese language.

Software Agents and Japanese Language Learning

A software agent (Nwana, 96) works on the behalf of the user, reducing her/his work and information overload (Maes, 94). Here we refer to the term agent as an entity that functions continuously and autonomously in an environment in which other agents exist (Genesereth, 94). Of particular interest to the life-long learning approach is the work of Norrie and Gaines, introducing the Learning Web as an agent based distributed intelligent learning environment (Norrie, 95).

There have been proposals in the modeling of agents for Japanese language collaborative learning environments (Ayala, 95). With GRACILE (Ayala, 98) we proposed a collaborative learning environment where foreign students learn by constructing a dialog together, applying vocabulary, language patterns and expressions of the Japanese language. The agents in GRACILE are implemented in PROLOG and work on a local area network of Macintosh computers, since GRACILE was designed as a second language collaborative learning for the enculturation of the learner (foreign student) in a geographically defined community (a school of a given university), with its own language characteristics. In SALLE the interaction of learners is indirect, through their contributions to a virtual community knowledge base via the Internet, and there is not a collaborative task to be solved synchronously by a small group of learners, as in GRACILE. The *virtual* community of practice in SALLE is indefinitely wide, and the members participate by cooperating asynchronously at any time from anywhere. The software agents in SALLE have been designed based on an object oriented methodology, which permits its implementation as a set of software components in JAVA (Bigus, 98), allowing the client to be platform independent.

In SALLE we have modeled four software agents; an *information agent* that works on the acquisition of knowledge from html files in the WWW, a *facilitator agent* that assist the learners in the social construction of knowledge, a *knowledge negotiation agent* to allows the learner to agree or disagree in a viewpoint provided from other member and a *knowledge agent* that applies language patterns and vocabulary, providing assistance concerning their reading, meaning and use.

Knowledge Agent

The knowledge agent in SALLE plays three important roles in the learning environment:

a) *Management of the knowledge base.* The knowledge elements (nouns, expressions, adjectives, verbs and the corresponding language patterns for their conjugation, together with their meanings and readings) are organized, accessed and registered in a knowledge base of the community, implemented through a DBMS.

b) *Recognition of knowledge elements and language patterns.* Recognition of conjugated adjectives and verbs, as well as nouns and expressions provided by the information agent, obtained from Japanese material in the Web or by the facilitator agent, from contributions of nouns and expressions by the members of the virtual community.

c) *Assistance.* Pedagogical presentation of the meaning, pronunciation of nouns, expressions, and language patterns analysis of conjugated adjectives and conjugated verbs. The knowledge agent provides the meaning together with the conjugation features of the pattern involved, the reading of kanji (furigana) and the corresponding meaning in English. In this way, it helps the novice and advanced user to understand the Japanese language pages s/he is reading while navigating the Internet. The knowledge assist the learner, applying its vocabulary and the language patterns and expressions. The requests of analysis from the learners may be in hiragana, katakana or kanji.

In our first prototype version, the knowledge agent contains around 2,000 nouns considered of frequent use. Their representation includes hiragana and kanji compounds. Around 400 of them are in katakana. Each noun object includes its meaning in English and, in the case of a kanji compound, its reading (furigana). A request to the knowledge agent from a learner, concerning a noun, can be in English or in Japanese, using hiragana, katakana of kanji. The user can copy a kanji compound from a text (e-mail or WWW site in Japanese, for example) and paste it into the request dialogue. Then the knowledge agent will show the corresponding reading and the meaning.

Utterances which do not obey a language pattern are called expressions (Alfonso, 89). These are referred to greetings, apologies, etc. The knowledge agent contains more than 200 frequently used expressions including their reading meaning in English.

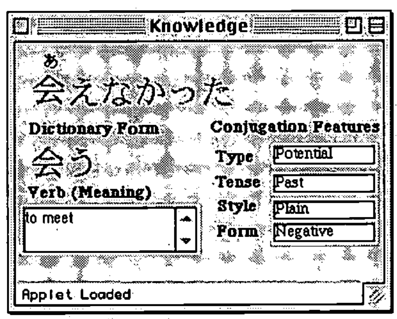

Figure 1. Analysis of the knowledge agent from a given verb.

Language patterns

We consider a language pattern as a template which represents a general structure that includes conjugation forms and grammatical particles (Alfonso, 89). The knowledge agent contains the language patterns for the conjugation of verbs and adjectives, and applies them when constructing a conjugated verb or adjective, under the learner's request, or while analyzing text (tokens) provided by the information agent from html files in the WWW or asked by the learner.

The knowledge agent currently contains more than 100 adjectives, together with all the language patterns corresponding to the adjective conjugation rules according to the Japanese grammar. The knowledge agent is able to recognize a conjugated adjective either in hiragana or kanji. The knowledge agent provides the meaning in English and the information of the language pattern used for the conjugation of the adjective, together with the respective kanji and its reading. It is also able to conjugate a given adjective in English, with the corresponding conjugation features indicated by the learner.

The knowledge agent currently contains more than 900 verbs, together with all the language patterns corresponding to the verb conjugation rules of the Japanese grammar. It is able to recognize conjugated verbs, either in hiragana or in kanji, taken from text obtained from the WWW by the information agent or requested by the user. The knowledge agent manipulates its language patterns and provides the meaning, kanji reading, dictionary form of the verb and the conjugation features corresponding to its language pattern for verb conjugation (see figure 1). When the learner asks for the conjugation of a verb, s/he selects the verb and the conjugation features in English, and the knowledge agent presents the results indicating the conjugation in Japanese and the reading of the respective kanji.

Information Agent

Japanese language learners have special topics and interests. In SALLE people learn more independently using materials that meet their individual needs. The information agent has been designed in order to determine the real, relevant and truly useful knowledge of the Japanese language. It helps in the recovery of Japanese text from html files, navigating through the Internet starting its travel from the favorite urls provided by the user, which represent her/his topics of interest. In this sense, the information agent is a "Web spider" or "indexing robot". The information agent keeps track of the Web sites already analyzed, autonomously checks for new information on them (nouns, adjectives and verbs) and provide it to the knowledge agent, which will register it into the community's knowledge base.

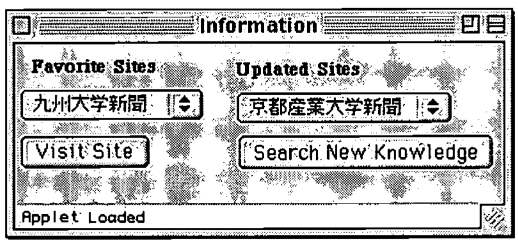

Figure 2. Information Agent Interface

The learner visits one of her/his sites being sure that it still contains material and that the knowledge agent already included nouns, expressions, verbs and adjectives from that site. This is because her/his information agent autonomously checks all the favorite sites and remove from the list those which are not longer available. On the other hand, it provides a list of updated sites which refer to those favorite sites that have been updated since the user's last visit (see figure 2).

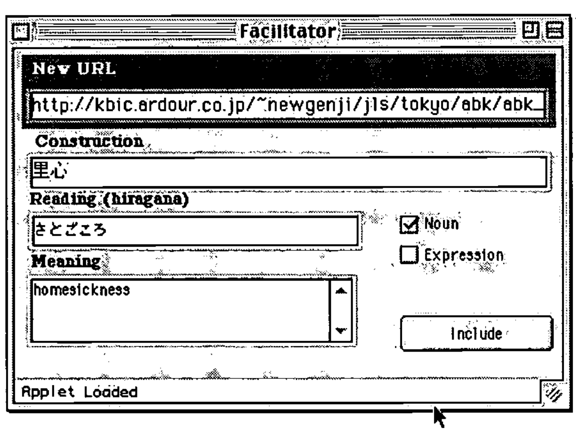

Figure 3. Facilitator Agent Interface

Facilitator Agent

With the facilitator agent we are implementing how distributed knowledge can be turned into shared, collective knowledge of a virtual community. According to the constructivism approach in learning environments (Resnick, 96), knowledge is also constructed by the learner, not just acquired from browsing or attending presentations. Interacting via SALLE learners participate not just passively reading educational material in the Web, but as active agents in the construction of new knowledge, with the help of others (Berger, 98a). According to this learner centered approach in the design of learning environments, the learner develops first a sense of ownership of her/his knowledge and later share it while participating in the virtual community of practice.

In SALLE learners are allowed to write their own understanding of nouns and expressions registered by the knowledge agent (from the tokens given by information agent) and which has not a reading and/or meaning associated. The learner can provide the reading and meaning to expressions and nouns used in her/his personal context. The facilitator agent allows the provision of new nouns and expressions together with their meanings and proper use to the knowledge agent (see figure 3). Later, with the help of a knowledge negotiation agent the community will be aware of the different viewpoints and adopt those believed correct and meaningful contributions. Also, students are invited to locate and define Japanese Web pages according to their interests. New urls for the information agent are provided through it (see figure 3).

Knowledge Negotiation Agent

Knowledge negotiation (Moyse, 92) is an important topic for computer assisted education and life-long learning. Life-long learners need to develop a critical attitude, giving more importance to their own constructions (what their discover or believe is true in practice) than to the theoretically correct knowledge indicated in an authoritative source, as in the case of a book.

In SALLE knowledge is distributed in each member and later shared among the participants via the facilitator agent. Each noun or expression provided by the learner may imply one with a different viewpoint concerning its reading or meaning. Therefore it is necessary to allow the learner to approve or reject the ideas of their peers, justifying her/his position. The role of the knowledge negotiation agent is to decide the delivery of new knowledge from the facilitator agent to the knowledge agent, based on the social acceptance of knowledge, and including the comments (justifications) of the beliefs provided by the community members. The knowledge negotiation agent promotes the agreement of members and at the same time consider their status in the community (novice, advanced or native speaker) in order to help the other learners to consider their contributions (see figure 4).

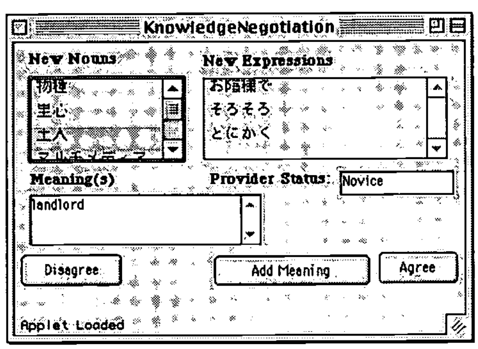

Figure 4. Knowledge Negotiation Agent Interface

Conclusions

SALLE is a prototype for a life-long learning environment based on software agents modeled for the social construction and use of Japanese language knowledge. This is our first step in the proposal of a paradigm of agent based life-long learning environments for Japanese language, as a space for the application and social construction of knowledge. We believe that the development of environments where learning is based on the actual and real content and use of knowledge, taking place at any time and any place, will be the future for all the life-long learners of the Japanese as a second language worldwide.

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Revisiting the Web-based Performance Support Systems for Lifelong Learning: Learner-Centered Resource Development Tool

Joanna C. Dunlap, Ph.D.
University of Colorado at Denver
U.S.A.
Joni_Dunlap@ceo.cudenver.edu

Abstract: Influenced by generative and intentional learning environment strategies and tools, a Web-based tool has been developed to empower learners to build their own Web-based Performance Support Systems (WPSS) to support their learning, professional development, and performance within a domain. The original version of the WPSS tool was presented at ED-MEDIA 98. The original version did not address the need to create unique Web-based resources when available WWW resources did not meet the learners' needs. Using document sharing, synchronous chat and whiteboard technologies, a learner-centered resource development tool has been incorporated into the original WPSS structure. In this way, the WPSS not only enables learners to (1) build a learning and performance resource that will provide them with immediate support and guidance and (2) help them develop structure, strategies, and skills for subsequent lifelong learning activities, but also (3) take responsibility for creating original resources that support lifelong learning and performance support.

[**Note:** A full version of this paper is available at http://www.cudenver.edu/~jdunlap]

What do you do if...?

- Your company has just completely a major reorganization in which a number of number of positions — including yours — have been restructured and responsibilities reassigned. Now you are required to work on tasks you've not done before.
- You're a UNIX programmer for a company that has decided to replace its UNIX servers with PCs. Now, all new application development must be done for the PC platform.
- You've been a technical writer in your organization for three years. Now, in a move to reduce costs and build in quality assurance measures, instead of out-sourcing the desktop publishing of the documents and manuals you develop you will be required to "publish" the documents yourself.
- Your company has caught the WWW bug and wants to implement a company-wide Intranet. You've been assigned to convert the print-based Employee Handbook to an HTML document — by next Friday!

In a climate of rapid change, increasing innovation, emerging technologies, and proliferating knowledge, lifelong learning is a necessary professional development objective. In order to keep current, people have to be willing and able to continually "retool" their knowledge and skill base. Simply knowing how to use tools and knowledge in a single domain at a specific point in time is not sufficient to remain productive and competitive. People have to face new domains and novel situations with increasing frequency due to the information explosion (Nash, 1994). The need to be a continuous learner is especially apparent in domains influenced by scientific and technological advances; these advances cause knowledge and skills to become obsolete overnight. To deal with today's complex workplace environment, employers need personnel who possess contemporary skills and knowledge, and are willing and able to proactively update their abilities to meet the ever-changing needs of the organization. Employees who are able to keep up with the information explosion are valuable assets; employees who fail to "grow with the flow" are restructured out of their positions. Therefore, lifelong learning is essential to staying current, competitive, productive, and innovative in today's workplace, and therefore employed and in-demand.

Following the prescriptions of the generative and intentional learning methodologies that promote the development of metacognitive and self-directed learning skills to support lifelong learning activities, a Web-based development tool was created. This tool was designed to help people in a workplace environment generate their own, individualized Web-based performance support systems (WPSS) to address the concerns described above by encouraging and providing a supportive structure for lifelong learning activities.

Lifelong Learning Defined

Lifelong learning is any purposeful learning that people engage in throughout their lives; it is an activity engaged in. to gain greater individual self-fulfillment and to improve the quality of life for the individual and the emerging society (Overly, McQuigg, Silvernail, & Coppedge, 1980). The knowledge explosion requires professionals to engage in lifelong learning if they intend to stay current — let alone evolve, advance, and remain competitive — in their profession. Therefore, lifelong-learning skill development is imperative if people are expected to learn over the full expanse of their professional lives. In order to better prepare for lifelong learning activities, learners must be exposed to learning activities that require them to take on and develop many of the responsibilities normally afforded to educators. To achieve this requires moving away from a view of learning that is controlled outside the individual — by a teacher, trainer, instructional designer, or subject matter expert — to a view of learning that is internally controlled by the individual (Overly et al., 1980). Therefore, in order to internally control the learning process, the development, and subsequent successful application, of two skill areas -- metacognition and self-directedness – is required.

Metacognition

Von Wright (1992) defines metacognitive skills as "the steps that people take to regulate and modify the progress of their cognitive activity: to learn such skills is to acquire procedures that regulate cognitive processes." Glaser (1984) describes metacognitive or self-regulatory skills as knowing what one knows and does not know, predicting outcomes, planning ahead, efficiently apportioning time and cognitive resources, and monitoring one's efforts to solve a problem or learn. More specifically, metacognitive skills that are required for lifelong learning include the (Ridley, Schutz, Glanz, & Weinstein, 1992):

- recognition of content and skill limitations;
- ability to set goals and create action plans based on those defined limitations;
- ability to activate the appropriate prior knowledge to achieve set goals;
- ability to accurately assess progress in learning and task performance and effectiveness of learning resources selected;
- awareness of what still needs to be completed to reach a set goal, and how best to allocate time and resources; and
- ability to modify strategies, tactics, processes, and resource selection based on the needs of the task at hand.

Self-directedness

Self-directed learning is:

> ...the process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing learning strategies, and evaluating learning outcomes (Knowles, 1975).

The domain of medicine provides a perfect example of self-directedness. When dealing with patients, the doctor has to begin assessing the patient's condition before having all of the data necessary to evaluate, diagnose, and treat the patient. Characteristically, the patient provides the doctor with fragments of information ("My stomach hurts. I can't hold any food down. No one else in my family is experiencing any problems."). The rest of the information needed to solve the patient's problem comes from the study of a variety of other resources: patient and family history, laboratory results, x-rays, other doctors' opinions, past experiences, similar cases in the case file, and current research findings on new diagnostic and treatment procedures. These skills utilized by the doctor to collect the necessary information to solve the patient's problem are described as "self-directed learning skills" (Barrows, 1985, 1986).

Barrows (1995) defines the process of self-directed learning as utilizing the following skills to solve a problem or fulfill a learning requirement:

- the ability to identify and define a problem/learning need;
- the ability to identify, find, use, and critique resources for solving the problem or meeting the learning requirement;
- the ability to capture and apply information from resources to the problem or learning need; and
- the ability to critique information, skills, and processes used to solve the problem or meet the learning requirement.

So, how do we develop lifelong learning skills?

In order to develop lifelong learning skills, the learners need to be directing and driving the learning process and activities based on their learning and performance needs. Two instructional methodologies that specifically address the development of lifelong learning skills are generative learning and intentional learning.

Generative Learning Environments

Generative learning environments require students — individually and collaboratively — to be responsible for creating, elaborating, and representing domain knowledge in an organized manner (Cognition and Technology Group at Vanderbilt, 1992; Hannafin, 1992; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989; Scardamalia & Bereiter, 1991). Through a this process of "generating" knowledge, instead of passively receiving information, learners develop structure, strategies, and habit for lifelong learning.

Generative learning environments require students to take responsibility for determining what it is about a particular domain they need to know, and then direct their activities accordingly to effectively research, synthesize, and present their findings. Schank and Jona (1991) describe a generative learning environment in their discussion on the research method of teaching. Under the research method of teaching, students are asked to research a particular topic and then present their results to others (the class, a collaborative group, etc.). In this way, students are taking over the responsibility of information gathering and synthesis and dissemination/presentation from the teacher. For this teaching method to lead to successful learning, students need to be allowed to select their own topics to research and report on, so that they have a real interest in proceeding with the assignment and have more control over their learning. Because the learning is student-directed, where each student makes choices and takes responsibility for those choices, the learning is more meaningful; "...in general, material that is organized in terms of a person's own interests and cognitive structures is material that has the best chance of being accessible in memory" (Bruner, 1961). In addition, because students are responsible for selecting a topic, developing a question to research, making decisions about how to gather information, analyzing and synthesizing information, etc., they are engaging in activities that help to develop high-level thinking and problem solving abilities.

Intentional Learning Environments

Intentional learning refers to the "cognitive processes that have learning as a goal rather than an incidental outcome" (Bereiter & Scardamalia, 1989). Intentional learning encourages students to take "an intentional stance toward cognition" (Scardamalia & Bereiter, 1991), which means that learners must learn how to monitor and be aware of their own learning processes, and take responsibility for pursuing desired and/or required learning outcomes. Intentional learning is learning that is actively pursued by and controlled by the learner (Resnick, 1989). Palincsar and Klenk (1992) describe intentional learning as an achievement resulting from the learner's purposeful, effortful, self-regulated, and active engagement. By encouraging students to take "an intentional stance toward cognition", intentional learning helps students learn how to not only monitor and be aware of their own thinking and learning processes (i.e., metacognitive skills), but also to take responsibility for pursuing individually-determined learning goals (i.e., self-directed learning).

The objective of an intentional learning environment is to create a supportive structure in which students can engage in cooperative knowledge building as they move towards greater autonomy. Addressing students' need for higher-order abilities in thinking and learning, intentional learning helps students develop the general metacognitive and self-directed learning skills that facilitate autonomous lifelong learning (Palincsar, 1990; Scardamalia et al., 1989). These skills are developed by engaging students in situations in which they need to build a body of knowledge based on their learning interests and needs using a variety of information resources. While building the knowledge base, students practice tactics for making claims, collecting evidence in support of their claims, and evaluating and responding to counterarguments from peers and teachers. Throughout this knowledge-building process, students reflect on specific aspects of their learning and thinking processes, and consider the effects of collaboration on each other's learning, such as the impact of opinion, bias, controversy, debate, and negotiation (Glaser, 1991).

Throw them all together and what do you get?: Web-based Performance Support Systems (WPSS)

Influenced by generative and intentional learning methodologies as well as electronic performance support systems (EPSS) technology, I developed a Web-based tool empowers learners to build their own Web-based Performance Support Systems (WPSS) to support their learning, professional development, and performance within specific domains. Similar to electronic performance support systems (EPSS), a WPSS uses the Web to provide on-demand access to integrated information, guidance, advice, assistance, training, and tools that support high-level job performance. In fact, using the Web to create performance support systems is a perfect fit because the Web is actively used by professionals as a forum for the distribution of current and up-to-date references, instruction, and guidance.

By creating a structure that supports individualized and collaborative knowledge building by the people who will actually be using the knowledge, the higher-order thinking, problem-solving, and decision-making involved in the selection and utilization of appropriate learning materials and performance support is done by those who can get the most out of the process. In addition, because these activities occur in the workplace and are driven by the needs of the job at hand, the learning activities are contextualized, authentic, and meaningful. Enabling people to utilize an easy-to-use tool to develop their own WPSS accomplishes two goals:

1. they learn about the domain while they are locating, evaluating (which requires utilization of resources), and organizing resources to support their job performance activities and/or their generative and intentional learning activities; and
2. once the WPSS is completed it can be used to support performance and further professional development while working in that domain.

In this way, the WPSS not only enables learners to build a learning and performance resource that will provide them with immediate support and guidance, but also helps them develop structure, strategies, and skills for subsequent lifelong learning activities.

Overview of Original WPSS Development Tool Components

The WPSS development tool helps employees -- collaboratively and as individuals – organize, assess, and utilize Web-based resources. In order to build an effective WPSS, the development tool enables employees to organize Web resources into a variety of self-determined categories. Categories may include:

- cue cards: brief definitions, reminders, directives, job aids, best practices
- computer-based instruction: tutorials, case studies, practice activities
- wizards: intelligent demonstration/application functions; assistance
- coaches: response sensitive correction and feedback
- mentors: individualized responses to questions from experts in the field
- practitioner forum: access to other practitioners in the field
- examples
- tools

In order to build a WPSS that meet individualize, specific learning and job performance needs, employees engage in a number of generative and intentional learning activities including:

- determining their learning needs and goals
- developing a plan for action for finding resources to help fulfill those goals
- researching Web resources that meet the appropriate needs
- utilizing Web resources in order to evaluate usefulness, difficulty level, strengths and weaknesses
- updating links to Web resources when appropriate
- responding to other learners' comments regarding WPSS contributions
- developing Web resources via HTML pages and threaded discussion forums

In other words, employees practice and develop the very skills and strategies needed to engage in lifelong learning activities while they are learning domain-specific content and skills needed for thcir jobs.

Overview of New WPSS Development Tool Components: The Learner-Centered Resource Development Tool

Although the original implementation of the WPSS was successful, it had a major flaw: it relied on pre-existing Web resources. People using the WPSS had to rely on the WWW to provide the various resources needed to create a knowledge base that would support their learning and performance support activities. For the most part, the WWW provided the resources needed. However, especially in Intranet environments in which employees needed access to organizational specific resources that did or did not already exist, the WPSS failed to meet the learners' needs. Therefore, a tool was created to enable people -- as individuals or in collaborative groups – develop unique Web-based resources for inclusion in the WPSS.

The Learner-centered Resource Development Tool (LRDT) combines the technologies of document sharing and synchronous chat and whiteboard to create an environment in which people can develop -- from scratch -- their own Web-based resources. The LRDT uses synchronous chat and whiteboard features to provide a forum for group brainstorming about the contents of a new resource document. The document sharing feature:

- enables learners to track and archive various versions of new resource documents,
- utilizes asynchronous threaded discussion technology to allow reflective discussion around the development of new Web-based resources, and
- provides easy uploading and downloading of resource documents for revision purposes.

The LRDT, now in beta testing, extends the usefulness of the WPSS by empowering WPSS users to develop their own Web-based resources.

Examples of the WPSS in Use

Although still in a formative stage with enhancements being added all the time, there are a number of examples of the WPSS tool in action. These WPSS examples can be viewed for examination purposes only at the following URL: http://www.cudenver.edu/~jdunlap/wpss.html

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Strategies for Selecting Technology for Education:

Choosing the Right Tool for the Job

Robert Fröhlich
Nanyang Technological University
School of Communication Studies
Singapore
tfrohlich@ntu.edu.sg

Abstract: This paper examines the requirements for choosing software and New Media technological solutions to facilitate future delivery platforms for Education. It outlines evaluation models and instruments for selecting software, and discusses various media, both current and future, which may aid pedagogic delivery. Through appropriate use of technology and software, selected in accordance with the models outlined, learning experiences may be enriched and learners may actively engage in their individual learning experience despite differing learning styles.

Introduction

The explosion of technology that has recently occurred, has forced many educators to be faced with the daunting problem of identifying appropriate technological solutions for Education. The task of selecting appropriate technology for the development of curricular resources for educational application, is something for which few educators have received any formal training, but are often required to undertake in the course of their employment. There are technologies that have been common place in classrooms for many years. These include the blackboard, over-head projector (OHP) and whiteboard.

New media technologies are not so common in educational institutions, although they are becoming more common as time goes by. One relatively new technology which has been employed by many educators, is computer projection using presentation software (i.e. PowerPoint) and LCD screens on OHP's or dedicated computer projectors. With the rapid evolution and convergence of New Media Technologies, educators are being told that they must adapt their delivery styles and make use of these new tools for education. Also, the entire delivery of education is said to be about to undergo a paradigm shift with the proliferation of distance education.

How do we go about selecting hardware and software for educational use, when we are not familiar with how it can be used? Do we just purchase the latest technology and then try to build a pedagogical paradigm around it. This approach may work if we have unlimited human and financial resources available to throw at these technological solutions, however, most educational institutions do not. Is it the technology that is driving pedagogy, or is the content available to make the technology merely a conduit for delivery? It is often beneficial to first look at what has not been successful in the past. Gayeski, D. (1989), identified a number of technologies which were hailed as being effective tools for education but failed to gain adoption. These include: Educational Television; Teaching Machines; Dial Access; Videotext; and to some extent Interactive Cable. Technologies were also identified with limited success, including: Video; and Visual Aids (Business Slides and Overheads). Questionable technologies were described, including: Teleconferencing; CAI; Interactive Video; CD-ROM; and AI. Now, some ten years later, these questionable technologies are undergoing a convergence to form part of the New Media Technologies.

We need to carefully evaluate technology before we adopt it. Learning paradigms can not be based on technology alone, but must be based on content. Information is not knowledge. It is not sufficient for educators to merely disseminate information to learners, who in turn may be able to recall this information when assessed and examined. The learners need to be able to apply the information in various situations for knowledge to indeed have been gained.

In evaluating technological solutions we need to take into account many factors, some of which are:

- Economic Viability - Capital Expenditure, Software Development or Acquisition, Operational Cost, Provision of User Help Systems, Maintenance, Upgrade Path.
- Software Availability - Suitability of Content to required learning environment, Development Cost
- Flexibility - Customisation feasibility.
- Reliability – Technical, Educational.
- Ease of use – Educators, Students.

When selecting technological solutions, the paramount concern must be to ascertain whether the pedagogical needs are best addressed by the tools under review, and whether they are economically viable. It is only through a carefully planned approach that it is possible to reveal the realisation of instructional objectives through their implementation.

Models

Different models have been developed for evaluating software, however, few are designed specifically for evaluating educational technology and software. Most of the existing models approach the evaluation from a wide perspective and, if anything, focus on user interface factors and not pedagogical factors. A pedagogical model for selecting educational software has been outlined (Komoski, P.K., 1995), which involves seven steps:

1. Analyse Needs	• Needs & Goals • Objectives
2. Specify Requirements	• Compatibility with Available Hardware • Cost – Multiple Copies? Site License Necessary? • User Friendliness • Level of Interaction Desired • Adequacy of Documentation • Access to Technical Support via Toll-Free Number • Direct Correlation with Instructional Objectives and Curriculum Requirements Identified in Needs Analysis *The following criteria should be applied within the context of the Objectives and Student's Needs.* • Content • Instructional Presentation • Demands Placed on the Learner • Technical Features • Documentation and Management Features
3. Identify Promising Software	• Educational Products Information Exchange (EPIE) • Listservs – AskERIC@ericir.syr.edu
4. Read Relevant reviews	• ERIC database etc.
5. Preview Software	• Observe Students • Are Educational Objectives Achieved? • Preview with own Students or Avoid Purchase!
6. Make Recommendations	• Select Most Desirable Software after Systematic Evaluation of all alternatives in terms of Educational Objectives and Constraints • Establish Quantitive Method for rating each alternative against the Selection Criteria established in Step 2 • Evaluate Relative Importance of each Selection Criteria – Preview should probably be rated high • Create Written Report
7. Get Post-Use Feedback	• Determine Conformance or Discrepancy to Enabling Objectives specified in Step 1

Software needs to be evaluated by educators before being implemented, in an attempt to enhance the learning experience of the students. Through the use of exemplary resources, students may then be offered a richer learning environment. However, to be able to truly evaluate technological solutions, including curricular resource software, one must first look at who the students are, and what is the desired knowledge to be conveyed. This investigation must be undertaken before we can look at the media available to support the curriculum.
Heinich *et al.* (1996) devised the ASSURE model as a procedural guide for planning and conducting instruction that incorporates media (technology and curricular resource software), specifying six stages:

A: Analyse the Learner
S: State the Instructional Objectives
S: Select Methods, Media and Materials
U: Utilise Media and Materials
R: Require Learner Participation
E: Evaluate and Revise

This model appears to be more useful because it involves the students from an earlier stage. It also facilitates a more iterative process through the inclusion of revision. An entire piece of software should not be ignored and discarded because it fails to meet all the instructional objectives. If it meets some of the objectives, better than the other products available, sections may be used as an effective tool to assist students with a particular segment of the topic.

Instruments

In order to be able to evaluate any software objectively it is good to have a well developed systematic instrument such as an evaluation form. This can be a quantitative instrument or checklist, where the evaluator simply ticks an appropriate box against a known grading scale or rubric (e.g. Poor, Fair, Good, Excellent) (Children's Software Review 1995). It can take the form of a questionnaire, where sufficient space is allowed for the evaluator to compare the software product to a known set of heuristics and write detailed comments; or it can be a combination of both.

A checklist is used by Children's Software Revue, where evaluators respond to items by ticking one of four possible responses (always; some extent; never; and N.A.-Not Averaged), to five categories of criteria. Through the application of evaluation rubrics, the California Instructional Technology Clearinghouse (CITC) have reviewed and categorised over 2,000 curricular resource software titles into a searchable database. Their evaluation is also divided into five broad sections, but in a much more pedagogical approach. The CITC provides for three levels of grading: makes an excellent case for recommendation; makes an good case for recommendation; makes an minimal case for recommendation. This approach seems to be a more quantitative approach, through the use of a checklist. The complete checklist can be viewed at: http://clearinghouse.k12.ca.us

New Media Technology

New Media Communication Hybrid Technologies, may facilitate learning to take place at any time and in any location. They may also enable the delivery of intelligent multi-layered interactive multimedia solutions which will help ensure that learners are absorbing the desired information, whilst not having to traverse subject matter which is already known. Some of the New Media Technologies, innovations, and devices which may shape.educational These technologies are paradigms and pedagogy in the new millennium are:

- Broadband Cable Data Networks and Satellite Data Transmission
- Video on Demand, High Definition Television, Digital Television and 3D/Omnidirectional Video Imaging
- Digital Versatile Disc
- Machine Translation
- Virtual Displays and Body Wearable Computers
- Intelligent Agents and Multimodal Interfaces

These technologies are outlined in Fröhlich (1998).

The facilitation of Education must always rely on content rather than the technology of the delivery medium. A well-drawn sketch on a blackboard can convey information much better than a poorly produced slide-show. The paradigms utilised in education have evolved over many years, however, it is only relatively recently that Multimedia has been able to fulfil an integral role in facilitating DL through being able to provide differing instructional techniques to suit different Learning Styles. Technology can be of great benefit in the delivery of Distance Education and DL, or it can become a barrier as well. Different people assimilate information through different cognitive paths and processes. Like a "Chinese Whisper" situation, re-transmission of information may continue, along with the addition of 'noise' and 'distortion', for a number of steps until the information transmitted bears little resemblance to the original information. This particular form of degradation of information rarely applies in Distance Education situations, because it is usually a single stepped process, however, the information may still not have been correctly understood by the learner. This may be through the addition of noise into the learner's cognitive process through the delivery of the information not aligning with their preferred learning style. To be sure that the information has been understood by the learner, it is best for them to have to put it into their own words or images, and transmit it back to the educator. This is usually achieved through the learner being subjected to answering questionnaires, completing exams and undertaking other assessment tasks.

In face-to-face delivery by a 'sage on the stage', the teacher usually has the benefit of having visual contact with the students and can gain feedback as to whether 'the lights are on' and whether the topic is being comprehended by the students. People rarely want to 'lose face' and appear ignorant by asking questions in front of their peers, so students are often inhibited in revealing that they are unable to follow the subject matter in front of the whole class. They may also be reluctant to make suggestions which may be perceived as incorrect (Koschmann *et al* 1995). Even experienced teachers are often unable to gain the required feedback as to whether they are teaching the students topics which they already know. The teacher is often unable to move on to another topic without boring and alienating some students by regurgitating information. Students usually respond to social pressure and complete classes even if they find the content boring and uninteresting. If the learning style of the student does not align with the manner in which the information is presented, the student may often leave with little more knowledge than when they entered. Even though students may have been presented with the required information, information is not knowledge. The cognitive transfer of information to knowledge may not have been facilitated through the style of delivery being mismatched with the student's learning style.

In asynchronous DL there is often no social pressure to stay and complete the class. Masie *et al* (1998) asserts that when students are on-line they are usually merely one click away from exiting the programme. Learners switch-off and leave for a number of factors, some of which are: "Been there, done that!"; "I'll never use that knowledge!"; "This site is SO slow!"; "I can't figure out what to do!" These factors need to be eliminated in order to keep learners motivated to complete the course. One way of maintaining interest in the learning process may be to utilise user-model based interfaces. A prototype form of user-model based interface, utilising adaptive link annotation, has been implemented on the WWW in the form of Adaptive Navigation Support (ANS). This has proved to be beneficial to student's learning as long as they accepted and followed the navigational advice provided (Eklund *et al*, 1998). In the future, more advanced user-model based interfaces should allow us to make use of styles of delivery which appear to the learner as being less didactic, but facilitate the absorption of information and the cognitive transfer of information to knowledge. The subject information needs to be designed for delivery in numerous ways to provide for different learning styles. These differing styles of delivery must be envisaged and planned for at the authoring stage of the courseware, and the delivery interface must also provide for this flexibility in delivery.

An intelligent agent (Woodnorth, 1998b) client interface may provide the learner with their prescribed topics in a controlled navigational environment. The learner may unknowingly be restricted from travelling to wherever they want, but would transparently be directed in their travels by the client. They may only be offered a limited choice of navigational paths and would be gently steered throughout the learning experience. The intelligent agent would constantly update a profile of the learners knowledge and preferred learning style through the use of audit trails and constructive evaluative exercises and tests. The pedagogical preference for Problem Based Learning (Camp, 1996) may be facilitated with students being given problems, then interacting with an intelligent agent to find a solution.

Conclusion

Communication Technologies and software, if selected carefully, may empower educators to construct rich learning environments where all learners can be actively engaged in their individual learning experience, despite their differing learning styles. Through the hybridisation of these new technologies the geographical barriers currently limiting the use of technology for education, such as lack of electricity, telephone and broadband infrastructure, can also be broken down so that learners universally may become more actively involved in their own education. It would appear that given the correct mix of technology and content, DL may finally come to the forefront of educational delivery. As education in the global village becomes more of a reality, and distance ceases to be the major limiting factor in the delivery of affective education, we need to exercise care so that the educational benefits are available to all citizens of the planet and that we do not further the creation of the new class system of information rich and poor.

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Content, Cultural and Client Issues: A CD-ROM Case Study

Joe Luca
Faculty of Communications Health & Science, Edith Cowan Univeristy
2 Bradford Street, Mount Lawley
Perth, Western Australia
j.luca@cowan.edu.au

David Wilson
PRISM Interactive
PO Box 555, Mount Lawley
Perth, Western Australia
david@prismgroup.com.au

Anna Sinclair
Education Department of Western Australia
Royal Street, East Perth
Perth, Western Australia
anna.sinclair@eddept.wa.edu.au

Abstract: Producing an educational multimedia CD-ROM in a culturally diverse environment provides a number of challenges. Content collection and validation, client education, choice of multimedia consultants, research into cultural beliefs, cultural sub-groups, geographically dispersed subject matter experts and agreement between content experts from various para professional disciplines are but a few. This case study traces the development of a CD-ROM for Otitis Media, a middle ear infection which results in Conductive Hearing Loss in young children, particularly indigenous children, from as early as a few weeks old through to their teenage years and beyond. The recurring incidence of Otitis Media during a child's early years may result in permanent hearing loss and is thought to have a significant impact on a child's educational, social and emotional development. Experience gained from this project highlights the critical elements of a project that must be considered when developing a multimedia CD-ROM. These include educating the client, scoping the job accurately, determining content availability, choosing appropriate consultants and setting up clear communication and decision making strategies to achieve consensus between subject matter experts from diverse disciplines.

Background

Otitis Media has been recognised as a serious problem for indigenous children for many years. When associated with Conductive Hearing Loss (CHL), it is the most common ailment experienced by children of the 90's [National Center for Health Statistics, 1992]. In New Zealand alone Otitis Media is estimated to cost the community $704 million per annum, an increase of 150% since 1975 [Allen, 1993]. Otitis Media is known to affect children from as young as a few days old through to their teenage years and beyond.

While much debate still exists with respect to the overall effect of Otitis Media, it is widely recognised that CHL with Otitis Media can cause children to suffer difficulties with their auditory, linguistic, social and educational development [Hasenstab, 1987; Kavanagh, 1986; Webster, 1988]. As a result, it is suggested that these children will also experience significant social and emotional difficulties during their early development. [Jacobs 1993] stated "The real cost of recurrent Otitis Media must be counted in terms of low self esteem, children who cannot make friends or children who are in the vicious cycle of failure at school".

[Rockeley & Rhys-Evans 1986], estimated that "up to 80% of all children experience at least one episode of Otitis Media by the age of 5 years with a peak occurrence between 6 and 18 months of age". Research in

Australia has shown that up to 70% of indigenous children in a classroom may experience Otitis Media with associated Conductive Hearing Loss at any one time [Lowell, 1993].

Project Objectives and Scope

In 1996 the Education Department of Western Australia in conjunction with Edith Cowan University undertook to produce a CD-ROM to increase awareness of Otitis Media and present caregivers with guidelines on the early recognition and appropriate intervention strategies that could be adopted to support children with Conductive Hearing Loss. "PRISM Interactive", a Western Australian based Multimedia Company was commissioned to provide design and production services for the development of the CD-ROM.

When the project was initially commissioned the target audience was identified as three distinct groups:

- children [4-7 years]who experience, or have experienced Otitis Media;
- teachers/indigenous education workers; and
- parents of children in the high risk groups.

As the scope of the project developed, the target audience was extended to include other caregivers responsible for the well being of children in their care and a range of para-professional groups such as health workers, audiologists and speech pathologists.

The key objectives of the CD-ROM were to:

- identify the common causes, signs and symptoms of Otitis Media with associated CHL
- identify the educational, social and emotional difficulties experienced by children with OM;
- provide a series of guidelines on appropriate intervention strategies that can be used to support children suffering from recurring Otitis Media;
- provide a comprehensive data base of support agencies/groups and teaching resources that can be used to assist children with OM;and
- provide children within the age group 4-7 with an understanding of the cause of OM, self help strategies that they can employ and identify those within their immediate family/community that can provide support.

As part of the scoping process, the Education Department of Western Australia established a working party whose members were considered leaders in their field of expertise. It consisted of 15 people including teachers, speech pathologists, audiologists, health care workers, indigenous education workers, ear nose and throat specialists, surgeons, and nationally and internationally recognised researchers in the area Otitis Media.

To commence the scoping stage the Education Department convened a two-day workshop with the working party, which generated much enthusiasm and ideas. The workshop also highlighted the following:

- the scope of the project was much broader than first estimated and the original project time frames were not achievable;
- it would be difficult to achieve consensus among the members of the working party on both the objectives and content of the CD-ROM;
- the Education Department of Western Australia (the client) had very little useable content; and
- the original budget was not going to be sufficient.

Content Collection Issues

When the budget for the project was initially developed, only a small amount of funding had been allocated for content collection on the premise that the client would be able to provide the necessary content to allow the project to commence. During the scoping process it became apparent that the client did not have access to this content and that insufficient funding had been allocated to this stage of the project. This left the working party with the dilemma of how the required content would be identified and collected to enable the commencement of storyboarding and multimedia production.

While this would normally have seen most projects suspended, the working party who were very much aware of the impact that Otitis Media was having on the development of young children volunteered their services to ensure that the project could proceed. Without this support, and the expertise of this group, it is unlikely that the project would have been completed. Such was the commitment of the working party that on one occasion a surgeon left the operating theatre to answer a question, leaving his assistant to continue with the operation!

During the scoping process it also became apparent that many of the para professional groups represented on our working party had dissimilar views on some of the finer aspects associated with the impact of OM on a child's development. In the absence of any defined source of documented content, a literature search was initiated to identify any content and research that would support the views that would eventually be depicted on the CD-ROM. This was to take three months to complete. As relevant content was sourced or developed, it had to be filed, referenced and cleared for copyright. The information collected required careful cataloguing to allow designers to quickly retrieve information when they returned to this material up to three months later.

However, new research findings kept emerging that caused continual changes in storyboards and on-screen content. While this was having a significant impact on the scheduled delivery date the working party felt that the latest research must be reflected. At this point it was decided that a Web site would be developed to complement the CD-ROM to allow access to future research findings.

With up to five different subject matter experts across each of the professions within the working party it was often difficult to reach agreement on the critical elements and treatment of the content. To overcome this issue, it was decided that the instructional designer would take the role of content identification and assessment. This person was perceived as not having a particular bias towards any particular discipline and was able to communicate and collaborate with all the subject matter experts. However, obtaining agreement on content still continued to have a significant impact on the project delivery date. Many of the subject matter experts were living in different states across Australia, so feedback and approval of storyboards was time consuming, often taking up to two weeks to be returned. In some instances storyboards underwent no less than twelve iterations before all the subject matter experts would sanction commencement of production.

To help make the process of content collection and approval more efficient, it was eventually agreed that only two subject matter experts would approve the initial content. Storyboards would then be circulated to the whole working party for final approval. This helped reduce the time required to validate the storyboards and the stress on the instructional designers!.

Cultural Issues

Apart from the difficulties associated with the collection of content, this project was made more difficult to manage due to the wide cultural diversity of the main target audience, Australia's indigenous population. The client was aware that within indigenous populations there exists many different groups, each with different cultural beliefs which had to be considered if the final product was to gain acceptance and be actively used as resource. This presented a major challenge for the design team resulting in the need to work closely with many members of different indigenous groups to identify and reach consensus on the appropriate treatment, interface design, learning styles, graphics styles etc.

While the design team was aware of many of the more commonly known cultural issues, on a number of occasions various segments of the program had to be revised in light of the feedback received from indigenous groups. Examples included ensuring that graphics did not depict children looking directly into the faces of adults, skin textures and facial features were not indicative of any one group and that consent was obtained from parents and adults shown in the videos or photographs. In Aboriginal culture once a person dies it is taboo to view the face of a deceased person. Even the way photos were transitioned on and off the screen had to be carefully considered to ensure that we did not offend the beliefs of Indigenous people.

This cultural diversity, and need to be aware of many different customs required a much wider cross section of the target audience be sampled than would normally be needed during the formative stages of the project. While this would have a significant impact on the time frame of the project it was considered critical if the project was to be accepted in all the indigenous communities that it would eventually be used in.

Project Resourcing & Client Education

As mentioned earlier the client had no experience of multimedia CD-ROM development and had little knowledge of the resourcing implications of such projects. Originally it was anticipated that the project would take about three months to complete (it eventually took eighteen months), with the belief that content was readily available or could be easily sourced. On this basis, an Education Department employee was allocated 25% of their time to coordinate the project. Unfortunately, even after the full scope of the project was known (and lack of available content), the time allocation for the client coordinator could not be increased.

As a consequence, the project became dependent upon the energy of a few people who contributed many hours outside normal working hours to collect content. During the latter stages of the project this extra burden, compounded by dealing with diverse subject matter experts and the impact of continual changes to meet varying cultural needs, was the cause of considerable personal stress for some team members.

This highlighted the need for "Educating the client" about correctly scoping a project, and having content and appropriate resources available before commencing a project of this size and complexity. Lack of content is an important issue in multimedia production which must be considered carefully before undertaking a project of this size. In light of our experiences we would strongly recommend that when undertaking a project of this nature a separate contract for the identification and collection of content should be completed before attempting to estimate the budget and production schedule.

Contracting the right people was essential to complete this project. Consultants were chosen who had completed similar work in the past. In this case it was important that the main developer had instructional design and CD-ROM production expertise. Checking the quality of past productions and asking previous clients about their satisfaction level gave a good indication of which consultants were suitable. Other attributes that were required in selected consultants included communicating honestly, clearly and on a regular basis with reporting schedules showing allocated responsibilities, and excellent interpersonal and team skills.

"The client will want a quality product at the cheapest possible price, and the developers will want the biggest possible profit margin!"

Copyright Issues

Copyright clearances were necessary for all media, teaching activities and papers that made up the CD-ROM information database. In some instances the design team discovered that some of the materials provided were not the legitimate property of the source. This resulted in the need to implement a policy where all content providers were required to demonstrate proof of ownership of the materials that they were supply. If sufficient proof of ownership was not available, then the materials provided were not used. While this occasionally restricted the amount of useable content that was identified it was necessary to protect the interests of all parties.

Information had to be maintained about each media element (graphics, text, video, sound & voice) used in production i.e. the source, ownership, shipping information, loan duration, copyright status, licensing and other relevant attributes needed to be stored and maintained.

Implementation Issues

As part of the implementation of this CD-ROM a policy on Otitis Media in Western Australian government schools is being developed by the Education Department of Western Australia. Professional development programs have been conducted in the sixteen education districts throughout the state to ensure that all teachers, school health workers, indigenous education workers and other caregivers are aware of the implications of Otitis Media, the availability of this CD-ROM and the manner in which it can best be used to educate the wider community. This process also involves groups from outside the education sector i.e. health, allied health, Aboriginal Medical Services and other community groups must be invited to attend the professional development sessions. However, as occurred during the design and production phase of the project, implementation has been hindered by the lack of resources necessary to conduct professional development. Without additional resources, concern is also held for the maintenance of the program.

Promotional materials and copies of the CD-ROM have been distributed free of charge by the Education Department to all government primary schools throughout Western Australia and will be provided at minimal cost to all other education sectors around Australia.

The Education Department of Western Australia has received numerous letters of commendation from many professional groups both nationally and internationally, including the World Health Organisation.

Although no structured marketing has occurred demand for the CD-ROM has outstripped supply and resulted in the Education Department outsourcing the reprint, distribution and future marketing of the CD ROM.

Recommendations

From the experience gained in this project, the following recommendations are made for anybody considering the development of a computer based training CD-ROM within a culturally diverse environment:

- have a thorough understanding of the content required and the resources needed to collect it;
- consider issuing a separate contract to identify and collect content prior to finalising the scope, budget and time frame of the project;
- educate the "ultimate client" , subject matter experts and other stakeholders about the key facets of managing, developing, coordinating, and resourcing a project of this size;
- insist on sufficient dedicated time and resources for a client coordinator;
- ensure that a strong representation of the cultural groups that make up the target audience are included on the working party;
- have a clear understanding of agreed objectives and adhere to these at all times to keep the project on track;
- ensure that costings and time schedules are not locked in prior to a proper scoping of the project being completed;
- ensure that the client is made aware at the beginning of the project of the resource requirements required to implement and maintain the final product;
- use developers and consultants who are experienced in this type of development;
- use subject matter experts and consultants who have good interpersonal skills, communication skills and a "good sense of humour"!

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Distance learning: the dispositions of students and the perceptions of colleges and employers to self directed learning and new learning technologies.

Dr David Warner, Director, Labor Market Research and Analysis, department of Employment and Training, Queensland, Australia
Email: davidwar@ozemail.com.au

Dr Gayre Christie, Senior Lecturer, Queensland University of Technology
Email: gayre@bit.net au

Abstract. Distance learning has played a major role in Australian education for much of the 20th century as distance and remoteness made access to traditional facilities very difficult for many. Now, however, it has become a mode of necessity for many people whose life/work styles, rather than geography, dictate how they can access education and training

The Australian National Training Authority has developed a national policy on 'flexible delivery', with considerable focus on learning in the workplace or 'on-the-job' (ANTA, 1996). It defined flexible delivery as 'commonly uses the delivery methods of distance education and the facilities of technology'.

The development of this policy was on the basis of a number of unexamined assumptions. These assumptions suggested that vocational education and training clients are sufficiently skilled to access training programs offered through flexible delivery, including on-line delivery.

The research reported in this paper set out to examine these assumptions.

Background

Distance learning has played a major role in Australian education for much of the 20th century as distance and remoteness made access to traditional facilities very difficult for many. Over time it developed also as a mode of choice. Now, however, it has become a mode of necessity for many people whose life/work styles dictate how they can access education and training. It is less about choice and remoteness today, and more about the pressures of work and life dictating an only viable mode: distance learning method.

The Australian National Training Authority has developed a national policy on 'flexible delivery', with considerable focus on learning in the workplace or 'on-the-job' (ANTA, 1996). It defined flexible delivery as 'commonly uses the delivery methods of distance education and the facilities of technology'.

However, the development of this policy position was made on the basis of a number of unexamined assumptions. These assumptions included: That vocational education and training clients

- want to learn through flexible delivery and on-line and have the capacity to take advantage of this;
- are sufficiently skilled to access vocational education and training programs offered through flexible delivery, and;
- can learn in the workplace.

The research reported in this paper set out to examine these assumptions.

Subjects

Students: Questionnaires were distributed to professional, trade and para-professional students who were concurrently in employment (worker/learners). The students were chosen from a wide range of occupations and from small medium and large workplaces. No differences in response were found by sex, size of enterprise or course.

Project Methodology

The research used questionnaire surveys, and structured focus group interviews to address the research questions.

Questionnaire

This is a very comprehensive 130 item likert-type scale in two parts. Part one canvasses student opinions about their abilities as learners and about their perceptions of and experience with various forms of instructional communication, including technology. It also canvasses their perceptions about their own abilities as independent learners. Part two uses a commercially available scale to assess subjects' self-directed learning readiness (Guglielmino, 1977).

Structured Interviews

These were conducted in focus groups with a sample of the worker/learners' employers and a sample of the TAFE teachers who were involved in teaching the worker/learners.

Results

Surveys were completed by 542 worker-learners Three hundred and twenty particpants were male and two hundred and twenty one female with one participant not indicating gender. Sixty eight percent were under twenty five years of age. The breakdown for size of workplace in which they were employed showed that thirty four percent were in small workplaces with less than twenty employees, thirty eight percent in medium workplaces with up to five hundred employees and slightly over nine percent were in large enterprises with more than five hundred employees.

Data also were interrogated for age between those under 25 years and those above. There were no significant differences for Part 1 of the Questionnaire, but there was a significant difference in relation to self-directed learning readiness. This was surprising for Part 1 because general assumptions about technology use would suggest that the older age groups were less confident and competent. This was not the case, although it needs to be recognised that neither age group reported high levels of competence or confidence with technology.

Questionnaire Part 1

Participants reported a substantial (high or medium) degree of confidence in themselves as learners (93.8%), said they were self motivated (92%), and could work independently with little direction (91.8%). However, nearly one-third (30.8%) said they were not capable of self-directed learning, with only fourteen percent strongly agreeing that they were capable of self-directed learning. In other words, respondents in the sample seem confident working under the supervision of a teacher, but not under their own supervision. It is interesting to note in a related study that Australian and Scottish students were less at ease with teachers than their United States counterparts, but were more open to self-directed learning (Christie and Warner, 1999).

Preferred mode of Learning

Respondents reported that traditional face-to-face learning was their most preferred mode of learning. This is shown in Table 1.

TABLE 1: Most Preferred Mode of Learning

PREFERRED MODE	%
Face to face	42

Learning Packages	5
Electronic	3
Guided experiential	5
Combination, inc. face to face	43

Further, fifty-five percent of all respondents believed that their future learning would be delivered face-to-face.

Learning Technologies

In the emerging area of learning technologies, participants reports give cause for concern in relation to flexible delivery. Forty-one percent had no computer based learning experiences, fifty-two percent had not experienced CD Rom learning and sixty-three percent had no experience of the Internet for learning. Only the Internet is reported on in this paper.

The Internet

For the majority of participants, the Internet was a new medium for which they reported low skill, or no experience. Their self-reports of competence are shown in Table 2.

TABLE 2: Level of Reported Competence in Internet Tasks.

Task	No Experience	Low	Medium	High
Accessing	37	18	22	19
Browsing www	43	17	18	18
Emailing	46	19	17	14
Downloading programs	50	18	15	13
Chat groups	51	15	19	11
Database search	47	17	19	18

Despite the above, participants did report that they perceived that the Internet would be useful for their learning (66.8%).

While sixty-three percent had no prior experience of the Internet, some sixty-two percent said that they currently have access to it either at home (15.5%), in the workplace (6.1%), or through their course provider (19.2%),. Eighteen percent stated that they had access to the Internet through more than one location.

These results give some cause for concern. They show that about two thirds of respondents had either no competence or no skill in performing Internet-related tasks. These findings endorse the observation that students require progressive exposure to the use of higher-end technologies to support their learning.

Questionnaire Part 2

Part two of the questionnaire dealt with an assessment of student's learning preferences and used a commercially available scale to measure this dimension of student readiness for self-directed learning. "Self directed learning is a strategy or a process whereby the learner accepts the responsibility for planning, seeking out resources, and implements and evaluates their own learning" (Brookfield, 1984. p.16). Scoring norms for this scale are depicted in Figure 1.

TABLE 3: International Norms for Learning Preference Assessment (Guglielmino, 1991) and Australian VET Sample

Score	***Level of Readiness***	***AustralianVET sample %***
252-290	High	8
227-251	Above average	19
202-226	Average	32
177-201	Below average	29
58-176	Low	12

Results revealed information which may give cause for concern. For example, the mean score on this scale for the Australian VET client sample is 202, with seventy three percent of the Australian sample scoring 226, or below. Comparison with international norms reveals that our sample has only low to average readiness for flexible learning. Forty one percent of the sample score only below average or low on flexible readiness.

Half of the students in the present sample possess below average to low readiness for self-directed learning and the scores for three quarters of the sample are average or below. This indicates that despite massive investment in flexible learning technology and infrastructure, the skill level of students may have remained unaddressed. The VET sector has apparently failed to acknowledge that similar investment needs to be made to ensure that clients can cope with flexible learning demands. The results call attention to the fact that mandating a flexible learning mode for all VET clients will potentially disadvantage three quarters of the client population. This is poor pedagogy and poor business.

However, a significant difference for age was identifies between those under 25 years and those above. The latter indicated a greater readiness for self-directed learning with some 40% scoring above average and higher, compared to 21% of the under 25 year group. This has implications for how course developers and instructors differentiate between younger post-school students and mature age students in the workforce.

The research findings do point to a cohort of VET clients with above average to high dispositional readiness and also with a range of self-directed learning skills, including the use of learning technologies.

Those clients with the attitude and skills that are disposed to flexible delivery do want choice. This is not readily available to them now. However, a collaborative approach in establishing 'virtual' provision of training could support these clients and provide a new framework of 'learning efficiency'.

Structured interviews with teachers

Overwhelmingly teachers believe that face-to-face delivery is more successful as a college strategy than other modes of delivery in promoting student learning. Optimun training is achieved through a combination of face to face learning with college lecturers, and workplace training and practice with workplace supervisors. A further critical factor, perhaps the most important factor in any method of delivery was described as interactivity.

The teachers interviewed said that a range of skills are required of students to profit from flexible delivery. They feel that students may possess some or all of these skills to varying degrees but few possess all of the skills at a sufficiently high level. The skills nominated by teachers were:

- Time Management
- Goal Setting
- Self-direction Skills
- Computer Literacy
- Technology Skills
- Basic Literacy and Numeracy
- Comprehension and Meta-Cognitive Skills

They perceived all of these skills to be essential for flexible learning. They did not indicate any teacher or institutional responsibility for helping students actually develop these skills. They generally attributed 'blame' to the students and their previous learning experiences or institutions.

Structured interviews with employers

The majority of employers interviewed were familiar with the term flexible delivery but most had some difficulty or confusion with the precise definition of the term. Most saw flexible delivery as somehow giving more emphasis or focus to the learner, and they saw it as more focussed on the individual rather than on the group.

Employers, without exception, mentioned literacy skills and numeracy skills as the most fundamental skills required of employees to benefit from any kind of training. Among the essential skills for flexible delivery success are:

- Literacy and Comprehension
- Problem Solving and Information Retrieval Skills.
- Analytical Thinking Skills
- Keyboard Skills

They saw these skills as more important than for example, computer literacy skills which they believe can more easily be taught on a just-in-time basis. Above all, employers believe that trainees need to come to the training experience with high levels of motivation to learn and high levels of self-direction skills.

Employers from larger workplaces knew more about flexible delivery and the needs of employees in relation to training. Larger workplaces tend to have more equipment than do smaller workplaces. They also tend to have more text-based resources and are more likely to be technologically better equipped. Overall larger workplaces seem better able to support students with more non-human support.

Conclusion

This study has found that the assumptions on which flexible delivery and online delivery are based are untenable. On the basis of the current research, the assumption that students are ready for flexible delivery of courses does not seem warranted. Both disposition and skill for self-directed learning were low on an international benchmark scale. Differentiation, based on age, however, could provide better opportunities for mature aged workers. Further, there is evidence from the interviews with VET teachers and employers that the VET sector has a limited understanding of flexible delivery and what might be needed for it to be successful. Teachers and employers generally saw the problem as belonging to the student/employee and resulting from poor previous school experiences. They identified skills needed, but did not indicate any belief that they might have a major role to play in enhancing the capabilities of students/employees.

In terms of the use of learning technologies, people in the VET sector have limited experience and competency of them as learning tools. While basic computing skills were evident, their reports did not indicate any real sophistication in higher-order computing or Internet skills. For both present and future learning there was clearly a preference on the part of students for face-to-face traditional delivery in college.. There was little evidence that their VET experiences exposed them to learning using new technologies or developing the skills to be able to learn thus. However, there were some indications that, given opportunity and learning skill, the students might well develop the disposition to learn differently. Certainly, there is no evidence to suggest that VET clients could not develop the capability to learn through flexible delivery. What needs to happen is an attitude change on the part of students, teachers and employers and attention given to the development of skills associated with flexible learning, particularly skills associated with new learning technologies.

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The Effect of Technological Paradigm Shifts on Established Educational Technologies: A Case Study of Audiographics

Allan Ellis
School of Social and Workplace Development
Southern Cross University, Australia
http://allan.scu.edu.au/ aellis@scu.edu.au

Roger Debreceny
Nanyang Business School
NanyangTechnological University, Singapore
http://www.ntu.edu.sg/home/adebreceny rogerd@netbox.com

Abstract: Audiographics technologies enjoyed a period of relatively widespread use and progressive refinement in the early to mid 1990's. Their growth and development was however paralleled by the growth and development of the Internet and the World Wide Web. Since the mid 1990s the functionality and appeal of collaborative Web-based tools has slowly gained favour amongst educators with the consequence that they have began to replace the more specialised functionality of established audiographics programs such as Electronic Classroom ® with the more diversified and increasing sophisticated Web-based programs. The low speed and poor reliability of phone line connections and congested Internet service lines are factors that can still give audiographics programs the edge in some non-metropolitan and remote areas. The results of a telephone survey of Electronic Classroom ® users indicates that audiographics use has at best stabilised and at worst is in decline in the face of an ever increasing array of Web-based collaborative tools. The detailed comments of Electronic Classroom ® users in relation to the decision abandon audiographics and move to another educational technologies will be presented as part of the conference presentation.

1. Introduction

This paper addresses the effect of technological paradigm shifts on investments in educational infrastructure, courseware and teacher skill sets. The paper reviews the paradigm shift that has occurred in educational information technology with the arrival of the Internet and the World Wide Web (the "Web"). The Web has literally affected all pre-existing educational information technologies to a greater or lesser extent. In this research we address the impact of the Web on one relatively widely adopted educational information technology: audiographics. This technology is a form of synchronous, distributed multimedia software. Audiographics is designed to support distributed learning across a range of educational levels. How have developers of audiographics software responded to the challenge presented by the Internet and the Web? Equally importantly, how have educational administrations, institutions and individual teachers reacted to the new opportunities and challenges presented by the Internet and the Web?

This paper proceeds as follows: In the next section, the nature of Kuhnian paradigm revolutions, or what are more commonly referred to as paradigm shifts, is discussed. The next section introduces audiographics educational technologies. We review the adaptation made by suppliers of audiographics software to Internet technologies. We then analyse the response of experienced users of a well-established Australian audiographics product, Electronic Classroom ®, to the changes brought about by the Internet and the Web. In the final section, we make some recommendations for further research into substantial changes or paradigm shifts, in educational technology.

2. Paradigm Shifts in Educational Technology

Kuhn (1962: 83), explains that a paradigm revolution in science occurs when a "continually resistant component of Science - an anomaly in the paradigm" occurs. He notes that a paradigmatic revolution "is complete when the profession will have changed its view of the field, its methods, and its goals" (Kuhn 1962:84). Paradigmatic revolutions "must occur all at once (though not necessarily in an instant) or not at all" (Kuhn 1962: 149). While the original Kuhnian view of a paradigm revolution was to describe the comprehensive shifting of plate tectonics in scientific disciplines, the more popularly accepted term of paradigm shift has come to represent a fundamental move in understanding and use of technologies or other human activity. For example, Capra (1982: 30) defincs a paradigm shift as "a profound change in the thoughts, perceptions, and values that form a particular vision of reality". The term has now entered into the public consciousness and has been used widely in a variety of disciplines.

There has been recognition in recent years of the importance of information technology in reshaping a variety of human endeavours. The work of Negroponte (e.g. Negroponte, 1995) and Tapscott (e.g. Tapscott 1995; 1997; and Tapscott and Caston 1992; 1993) have been influential in pointing to the fundamental implications of new computer-based technologies for the way that societies are organised. While the work of Negroponte, Tapscott and others have not been linked to any particular technology, we can say that the extraordinary move of the Web (Berners-Lee and Cailliau 1990; Berners-Lee 1997) from the relative confines of the high-energy physics community to the general global community, constitutes a paradigm shift, even a paradigm revolution, under any definition. In the space of less than a decade the Web has grown into an unfathomable multimedia resource. Intkomi Inc. estimates that there are more than 200 million publicly available pages on the Internet that a search engine can index. There are probably many more pages hidden behind corporate Intranets and database engines. The Web has affected the development of a wide variety of pre-existing information technologies from local and wide-area networks, to group decision support and collaborative systems to e-commerce and logistics.

3. Audiographics

Audiographics is a set of linked technologies that supports synchronous and distributed teaching and learning (Barker and Patrick 1989; Rehn and Towers 1994; Ellis, Debreceny and Crago 1996). In the "pre-Internet" period, an audiographic installation would involve computers at physically distributed teaching sites connected by modem and telephone line. The sites would also be connected by telephone line for voice. This is illustrated in Figure 1:

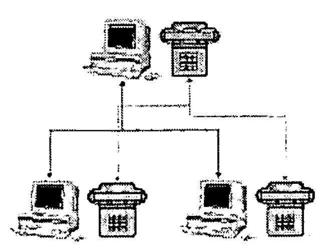

Figure 1: A basic audiographics installation

Typically, audiographics software supports one or more of shared whiteboards with graphics and chat features. In the case of the Electronic Classroom ® product, shared access to sounds and movies in QuickTime ® format was also provided. Audiographics was, for some time, the only multimedia computer-based form of educational technology that could support synchronous, different place interaction with graphical support. Of course, pre-Internet technologies such as bulletin boards and chat rooms could support such interaction, but in a text-only mode. The place of audiographics in the broader span of educational technologies is illustrated in Figure 2

	Spatial	
Temporal	same place	different place
Synchronous	Classroom activities - discussion groups, role playing	Audiographics, Distributed GDSS, Internet Pagers, Videoconferencing,

		Educational TV and radio, Teletutes
Asynchronous	Email, Listservs, Web discussion boards, RealAudio, Asynchronous TV	

Figure 2: Typology of Educational Technologies

Three products took the major share of the worldwide audiographics marketplace. These were Vis-à-Vis and Smart 2000 from Canada, both of which were in a Windows 3.11 and subsequently Windows 95 environment, and Electronic Classroom ® from Australia, which operated in an Apple Macintosh environment (Crago 1993). As might be expected, Electronic Classroom ® dominated the Australian marketplace, with substantial inroads being made in the Victorian and West Australian school system and, to a somewhat lesser extent, the NSW and Queensland school systems and higher education nationally. Electronic Classroom ® has provided the foundation for a number of experiments in distributed teaching and learning, many of which have been reported at previous ED-MEDIA conferences (for example; Ellis and Debreceny 1994; Arms 1997; Oliver and Lake 1997; Stoney and Oliver 1998).

Audiographics has been applied in a wide variety of educational environments, from primary school to higher and further education (Ellis, Debreceny and Crago 1996). Audiographics does, however, require rather intensive investment of resources. Each site traditionally required two telephone lines for voice and computer-to-computer communication. When there is long-distance synchronous teaching and learning, which has been the situation for many audiographics installations, there are additional communication costs. These costs may be substantial.

Ellis, Debreceny and Crago (1996) documented the progressive technical improvements in Electronic Classroom® functionality from version 1.0 in February 1990 to version 2.5.9 in June 1995. In April 1996, the release of version 3 allowed users to substitute point-to-point Internet connectivity for modem connectivity. This allowed users of try out IP networks instead of dedicated phone lines.

In contrast the Internet, has provided the promise of connection to local points of presence (POPs) at the cost of local telephone call. Further, with Internet support, only one phone line, for audio, is required. Migration to an Internet-based solution also opens up many opportunities for wider collaboration and alternative forms of collaboration. Synchronous teaching and learning can be integrated with asynchronous communication and collaboration by email, listserv or Web-based discussion board.

A large number of products have been developed to support synchronous and asynchronous collaboration on the Web. Products include chat tools such as ChatTouring, which, as the name suggests, is designed to support text-based synchronous chatting but with the ability to take participants in the chat to designated URL's. The chat participants' browser follows the lead of the URL that has been placed on the ChatTouring chat space. New synchronous tools have been developed in the Internet environment that was not possible with pre-Internet technologies. For example, the concept of a "pager" such as Mirabilis's ICQ allowed for participants to enter into dialogue with designated parties when those parties come onto the Internet.

Widely known products that most closely resemble "traditional" audiographics solutions in an Internet environment are CUSeeMe(TM) and ClassPoint(TM) from WhitePine, and NetMeeting(TM) from Microsoft. Each of these products supports audio, video, shared whiteboards and chat. Each is compliant with the ITU's H.323 standard on multi-point video conferencing. ClassPoint is also compatible with the T.120 standard on multi-point data sharing . Products based upon T.120 are designed to interoperate with H.323-compliant products. ClassPoint(TM) is an enhanced version of CUSeeMe(TM), which originated as a research project at Carnegie-Mellon University (Steele 1994). The product supports the multi-point audio and video of CUSeeMe(TM) as well as integration of Web-touring, along the lines of ChatTouring discussed in the previous paragraph. ClassPoint(TM) also provides for teacher control of the "classroom" environment as well as Web-based teaching and learning materials. NetMeeting has integrated audio, video, shared whiteboards, shared applications and chat. NetMeeting is, however, limited to two parties sharing audio and video, although others can share a chat room and shared applications. MeetingTools(TM) from DataBeam enhances NetMeeting(TM) to support a large number of users, albeit without audio and video support.

The pre-Internet audiographics products have made varying attempts to become Internet-friendly. None has, however, made the transition completely successfully. Developers of some of the products have tried to reduce the cost of ownership by multiplexing audio and data on the same telephone line (Klein, Pratap and Prestinario 1997). No evidence has been found for widespread adoption of such a solution. A product, which sits between

the traditional audiographics products and the newer generation of Internet products, is FarSite(TM), also from DataBeam. It does not support audio or video. FarSite(TM) has, however, extensive support for Internet-based collaboration tools.
In summary, the Internet now provides the promise of low cost synchronous collaboration with all the functionality of the pre-Internet audiographics products. At the same time, moving to an Internet solution provides the potential for teachers and learners to access the resources of the network and to leverage alternative synchronous and asynchronous Internet collaboration solutions. However it must be remembered that the reliability and speed of Internet connectivity varies widely. How did the users of pre-Internet audiographics respond to this paradigm shift?

4. A Case Study: Electronic Classroom®

4.1 User Telephone Survey

Format and questions
As discussed above, Electronic Classroom ® is a well-developed and widely used pre-Internet audiographics product. It has been in use in the secondary educational sector since 1990. Although most of the installations have been in rural and regional Australia, there have been applications of Electronic Classroom ® in urban environments. Typically, schools in a defined geographic area will collaborate to jointly offer classes that could not cost-effectively offered by individual schools in the consortium. By mid 1998 a total of just over 1000 Electronic Classroom ® licenses had been sold. This research was designed to track the decisions made by active users of Electronic Classroom ® in the period from approximately mid 1996 to mid 1998, that is, since the introduction of version 3, which allowed Internet connectivity to be substituted for modem connectivity, and over the time of rapid growth of collaborative Web-based tools.

A telephone survey of Australian users was conducted in August and September 1998. Revelation Computing, the developer and distributor of Electronic Classroom(R) supplied some contact details of users. Other contacts were added, based on the authors' knowledge of users from past research. The intention of the survey was to sample people who had not just purchased copies but who were known to have made some use of the product in the years prior to 1998. The survey was intended to be a simple pilot study. It was not designed as a comprehensive review of the entire product user base. Nevertheless the survey was stratified. It sampled metropolitan and country users in several Australian states. In Australia, primary and secondary education is the responsibility of educational administrations at the state level.

The majority of users were known to be active in the various state primary or secondary school systems. The age of students studying via Electronic Classroom ® sessions ranged from nine to eighteen years of age. The survey was not intended to be a detailed "product comparison" but rather an attempt to establish if any trends and changes were present and if so, how the trends and changes could be best characterised.

Some general points about the survey population and survey questions are relevant. By the very action of making use Electronic Classroom ® in their teaching and learning environment, users can be characterised as technologically literate, as innovators and as "early adopters" under the model proposed by Rogers (1983). Given this, it is to be expected that users would also be active experimenters with other related products and hardware that might be seen as offering similar features of perhaps even completely "new" instructional environments.

The structure of the survey involved a series of questions of two types: a number of optional, defined responses (e.g. Yes/No) or open-ended responses (a few sentences to a few paragraphs were recorded). The initial question was aimed at splitting the sample into two sub-groups:

Opening question: Are you still actively using Electronic Classroom ® in your teaching?

Possible responses: Yes or No

Depending on the respondents answer to this question one of two other sets of additional questions were asked.

If Yes:
1. Is your level of use: Possible responses: (a) higher then a few years ago, (b) about the same, (c) less than an a few years ago.
2. Have you looked for a potential replacement system? Possible responses: (a) Yes, actively, (b) No, but have checked out "similar" products, (c) No, not at all.
3. Have you considered any other products that might provide supplementary support? Possible responses: (a) Yes, (b) No
4. What do you consider are the current major strengths of Electronic Classroom ®? Give details.
5. What do you consider are the current major weaknesses of Electronic Classroom ® ?Give details.

If No:
1. What was your main reason(s) for abandoning Electronic Classroom ® ? Give details.
2. Has this move proved to be the right decision? Possible responses: (a) Yes, (b) No.

5. Results

5.1 The Yes group

The majority of users surveyed were in the Yes group, that is, Electronic Classroom ® was still being used by them and their organisations. However, the users reported that the level of use had stabilised or was declining. No one was actively looking for a replacement product but, as was to be expected, all were "checking out "similar Internet-based products that provided collaborative screen sharing facilities.

The majority of Yes respondents also reported they had considered, or even trailed the use of supplementary products. These included low cost, small window videoconferencing such as ClassPoint(TM) or CUSeeMe(TM). Use of such products was seen as a means of enhancing the feeling of personal contact between teachers and students and amongst the student population.

The features that were overwhelmingly reported as being the major strengths of Electronic Classroom ® were its tenacity at maintaining a continuous connection even over relatively poor quality telephone lines and its suitability for delivering a formally structured lesson based on already developed content. These comments come as no surprise as they represent the elements of the niche market that the product originally targeted.

In terms of major weakness most respondents said none. One respondent stated its inability to link with other similar products, in particular those that run on a Windows platform.

5.2 The No group

The main reasons for abandoning Electronic Classroom ® were related to the rapid spread and evolution of the World Wide Web and the availability of shared whiteboard and screen control software as well as the availability of low cost colour videoconferencing hardware and software. In metropolitan areas the availability of Internet connectivity, had clearly attracted several users into what they saw as a more information rich environment. This environment was seen as more popular with the respondents' students. Connection to the Internet was often centrally funded by the respective State Education system, and/or available, at relatively low cost, via commercial ISP's. This contrasted with the cost of phone connections with Electronic Classroom ® that requires expenditure of school budgets or the continuation of special grants from central administrations.

All No respondents believed that the move had been the right decision. Several did offer the comments that it had altered the structure of how online lessons were now delivered. The respondents felt that the "more direct control available when using Electronic Classroom ® had been lost". In contrast, the benefits of an Internet solution "were that the students were now searching for and creating more of their own resources". Clearly the popular appeal amongst the student population of creating Web pages had been a factor decision to move from Electronic Classroom ® to an Internet solution.

Details of individual responses to the phone survey will be incorporated into the conference presentation.

6. Conclusions

In this paper, we have introduced audiographics technology against a backdrop of a paradigm shift in educational technologies. We noted that new Internet-based products provided the functionality of pre-Internet audiographics applications. These Internet-based products allow users to use a single telephone line for video, audio and data as well as opening up schools to the cornucopia of resources on the Internet and the Web. At the same time, suppliers of audiographics software have not moved quickly to meet the demand for Internet solutions.

How did schools respond to these opportunities? The strongest supporters of Electronic Classroom ® remain users who want to deliver formally structured lessons and are located in areas where poor telephone line quality is unfortunately still the norm. Reliability of connection and poor bandwidth in a rural and regional environment mitigates against a change. Attempting to support audio, video, shared whiteboards and chat on a single telephone line requires high-speed lines and continuous quality. A product such as Electronic Classroom ® has a high level of Quality of Service (QoS). The QoS of the Internet cannot be guaranteed. Also this group has a major investment in prepared lesson content, which would not be easily exported to another environment.

The reason that usage levels have stabilised and the user base is not expanding is clearly related to the increasing number of Internet connections in schools, the availability of other screen sharing programs and the increasingly rich resource pool provide by the Web sites around the world.

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Finding An Educational Role For Performance Support Systems

Martyn Wild
Senior Research Fellow, School of Information Systems, Edith Cowan University
Pearson Street, Churchlands, Western Australia 6018
m.wild@cowan.edu.au

Abstract This paper will report the findings of a second study[1] to investigate the value of a Performance Support System (PSS) for novices undertaking a complex cognitive task (lesson planning), within an innovative instructional model. The intention of the research was to investigate the value in using performance support as a strategy for engaging learning, by describing how learning might occur as a result of using a specific PSS.

INTRODUCTION

The rationale for this research lay in the paucity of instructional design models or approaches for the development of educational software products, particularly for tertiary education. Furthermore, it was completed in the shadow of seminal comments by Brown (1994), and Park and Hannafin (1993), amongst others, which are proving increasingly representative of the field of instructional technology, and which strongly advocate the need for new and better informed (ie. by a greater diversity in research findings) instructional design models.

This research hypothesised the value of using a model of instruction based primarily in the theory of cognitive tools and in the design methodology of (electronic) performance support systems (PSSs), but also taking appropriate account of other cognitivist principles in instructional design, such as mental models, situated cognition and authentic learning. There were two orientations to the research reported in this paper:

1. Investigate how novice student–teachers engage PSS components in the Lesson Planning System (LPS)—a specific PSS designed to support the production of lesson plans.
2. Investigate the effectiveness of the LPS as a PSS to support the completion of lesson planning.

The space allowed here prohibits a full reporting of the data collected. Further refereed articles reporting on this and other data are published elsewhere—for example, see Wild (1998a; 1998c; in press).

PERFORMANCE SUPPORT SYSTEMS

A Performance Support System is interactive software that is intended to both train and support the novice user in the performance of tasks. Raybould describes a PSS, rather widely, as a, 'computer–based system that improves worker productivity by providing on–the–job access to integrated information, advice and learning experiences' (Raybould, 1990). Traditionally, PSSs have been characterised by their structure and the software resources they provide, and these are usually determined to include: an information base (eg. on–line reference and help facilities and case history databases); interactive and learning experiences; productivity software (often used with templates and forms); and, an advisory system (eg. coaching facility) (Gery, 1995).

THE CONTEXT OF DESIGN FOR THE LPS

At the core of the LPS is a model of lesson planning required by Edith Cowan University, Western Australia, and wider afield. This model includes essential components of lesson planning such as writing learning objectives, developing learning experiences and planning evaluation (Barry & King, 1993). Each component is supported by activities that instructs the user about the task (eg. provision of information relating to reasons why objectives are necessary, criteria for quality objectives), and which also assist the user in performing the task (eg. provision of a database of verbs to assist in writing quality learning objectives). A set of software tools are available to support each activity. A full description of the LPS can be found in Wild (1998b).

PROCEDURE

In the second of two major studies[2], five students, all female, were identified to provide the focus for studying their patterns of LPS usage over a two week period. These students were volunteers and self–confirmed novices in lesson planning. The students were tutored in the use of the LPS, to the point at which they felt comfortable with their skill in the use of the technologies (ie. computer and software use). Students then used the LPS to plan a minimum of six lessons, over a period of two weeks—producing these lesson plans so that they might be implemented in their professional practice placement schools within a day or so of their planning, and also subject to evaluation by a university supervisor, classroom teacher, and/or school principal or representative, as part of the normal operating expectations in the professional practice period.

Observational data was collected by video tape recordings, providing a complete record of use of the LPS for each student for each session of use. From the observational data, it was possible to determine a count of students' interactions with instructional and performance components of the LPS, and the amount of time it took for them to complete the lesson planning task using the LPS. Also, from this data, an instructional–performance (IP) coefficient was calculated to more effectively represent the changing nature of LPS usage over all lesson planning tasks. This coefficient is calculated by dividing the total number of instructional (I) interactions for each lesson plan, by the corresponding number of performance (P) interactions. For example, an equal number of instructional and performance interactions for one lesson plan, would provide an IP coefficient of one (1). Whilst there is no optimum IP coefficient indice, when calculated over a range of lesson planning tasks, for each student–teacher, the IP coefficients can provide an indication of the development of expertise in students' lesson planning skills.

Individual follow–up interviews conducted at the completion of the two week period (ie. within 15 days of the completion of the final lesson plan observed), helped determine how all students managed aspects of the lesson planning task. Interviews were conducted one–to–one, and comprised a series of open questions which sought to identify how students perceived they completed the lesson planning tasks, and probed why students performed and managed the task in the manner they described. The sixth and final video tape recorded for each student, was played back to the student at this point, to elicit a delayed think–aloud procedure, acting as a prompt for each student to offer explanatory comment on their actions and behaviours in using the LPS, over their whole period of use, and particularly addressing the notion of change and/or perceived improvements in skill performance.

Further, each of the six lesson plans produced was evaluated by an expert lesson planner (ie. lecturer or teacher), as a measure of product quality; and, as a means of gaining an indication of the strength of transfer in students' learning over media, these lesson plans were then compared to a lesson plan produced by each of the students by 'pen & paper' means, following their use of the LPS.

RESULTS

Taken together, there emerges consistent and strong patterns in the data (see Table 1). For example, the reduction in the use of instructional components is strong (21–9, or 57.1%), although less so if the fifth and sixth tasks (#5, #6) are discounted as unrepresentative (for which only two students provided data), (becoming 28.6%). Again, the reduction in the time taken to complete the lesson planning tasks, (34–13 minutes, or 61.8%) is very apparent—although, again, less so if the latter two tasks are removed from the calculations (becoming 44.1%).

Table 1: Lesson plans 1—6.

Lesson plans	LPS Components			Time (mins)
	Instruction (I)	Performance (P)	IP Coefficient	
L1	21	20	1.0	34
L2	18	19	1.0	25
L3	14	20	1.4	20
L4	15	21	1.4	19
L5	11	17	1.5	17
L6	9	14	1.6	13

Perhaps of more interest are the figures for students' use of performance functions in the LPS: very little change from one task to another over the first four tasks; and being reduced only in the fifth and sixth tasks

(20–14, or 30%), for which data was available from only two students. However, the most telling figures lie in the IP coefficients: the trend here is of a gradual and positive change, rising from 1.0 in the first task, to 1.4 in the third and fourth, and then peaking at 1.6 in the sixth task. The story in all these sets of figures and particularly those for the IP coefficients, is of students who develop their cognitive strategies in lesson planning using the LPS by the fourth task, and then refine those strategies thereafter, improving upon them more gradually over the remaining two tasks. Indeed, Figure 1 reveals more of the same story, suggesting the interaction in the instructional and performance interactions data sets that occurs just before the second task (#2), is the point at which the development in expert cognitive strategies first takes hold; but is only refined and consolidated at, or after, the fourth task (#4). However, as a cautionary note, it should be remembered that generalising in this way, does serve to mask the differences in the sets of figures recorded and analysed for individual students.

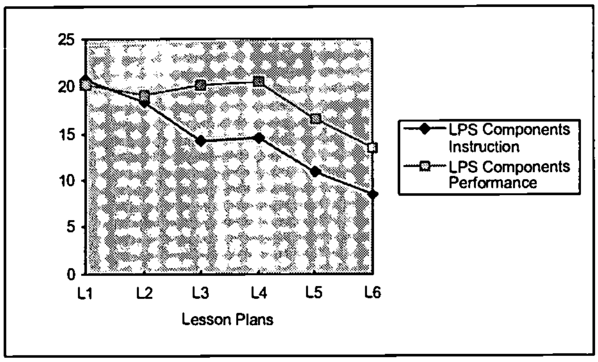

Figure 1: Lesson plans 1—6.

The temporal data, when plotted on a single graph (Figure 2), show that for all students, the time taken to complete a lesson planning task declined over the entire span of tasks (#1–#6). Also, for most students (ie. excepting students 2 and 3), this pattern of reduction is very similar: starting in the region of 34–46 minutes for the first lesson planning task; falling quite rapidly for the second and third tasks; and then declining more gradually for the remaining tasks. Of the two students (2, 3) who did not conform to this pattern, student 3 completed only three lesson planning tasks, making it more difficult to read patterns of any type into her data; and student 2 experienced a hiatus in the earlier data (where for tasks #2 and #4, the completion time rose by one to two minutes), but followed the broader pattern after task (#4). The data for all students increasingly converge over the last three lesson planning tasks, so that all students complete the final task in approximately 13 minutes.

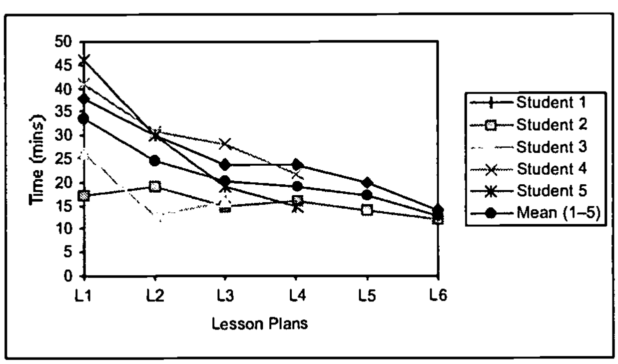

Figure 2: Time taken for task completion in the LPS for lesson plans 1—6.

Although there are similarities in both the interactions and the task–time data between the five students in their completion of the submitted lesson planning tasks, there are also some significant differences, described in full in Wild (1998b). Whilst each of the students experienced a reduction in the use of instructional components in the LPS over the series of tasks recorded, together with a strongly evident and corresponding reduction in task completion times, the patterns in their usage of performance functions are comparatively less alike—although, apart from two students, overall there are reductions in these interactions.

Beyond this, the data also suggest evidence of all students developing appropriate cognitive strategies for lesson planning using the LPS. For example, the data for two individual students (4, 5), when charted as line graphs (not shown in this paper), show interactions in the instructional and performance components interactivity data, at points somewhere between the second and third lesson planning tasks. It is at these points that the students have a ratio in the use of instructional–performance components, of one (1), and where their use of performance components begins to outstrip their use of instructional components. In addition, for these two students, the divergence between these two data sets that follows their interaction, suggests that such patterns in the data indicate the prevalence of cognitive strategies representative of expertise in the task. Even for those three students for whom there is no interaction in the instructional and performance components interactivity data, there is a pronounced divergence between these data sets at some point on individual students' interactions graphs (again, these graphs are not shown in this paper), a phenomenon which in itself is perhaps enough to indicate the development of expertise in the cognitive strategics being deployed.

Indeed, Figure 1, displaying the mean average in the interactions data for all students, suggests that the stage at which they begin to develop expertise in their cognitive strategies when using the LPS for planning lessons, (ie. the point at which there is an interaction in the instructional and performance components interactivity data) occurs very early on, at or just after the first task. However, it is evident that the phenomenon of the interaction in the data sets must be read in context, and in particular, that governing the nature and strength of the following divergence between these data sets. In this case, when all students are taken collectively, as represented in Figure 1, the pattern of divergence does not become soundly established until some point during or after the fourth lesson planning task (#4)—it is at this point on the graph, that the divergence pattern in the data stabilises.

INTERVIEWS

Interview data allowed for the richer documentation of students' cognitive processes and also increased accuracy (reliability) in interpretations offered in analysis of the video data. Whilst there is not room here to provide a detailed account of the analysis of each student's interview, it was clear from these analyses (Wild, 1998b) that the LPS supported a range of cognitive strategies, including that based in 'value adding', where there was clear benefits to be had from being able to word process to a template, to be prompted to check aspects such as lesson evaluation, and also to be able to provide well–formatted print–outs of lesson plans. There is additional evidence that students came to see their use of the LPS as a scaffold, which could be removed 'once you know what to do' (quote from student interview data). Furthermore, most students clearly evolved a confident, reflective and critical practice in their lesson planning, as part of the process of using the LPS: this is illustrated to a limited extent, in example statements for two students:

> After a couple of times, I really thought about what I was doing, about how I could make the lessons better. I used one of the... I copied one of the lessons in the program. Not really copied, I suppose... used it to get ideas from. It was really close to an idea I had anyway, of using cooking in science to get the kids to think about heat, the effects of heating water, evaporation. Once I had this lesson worked out, I used it as the foundation for my other lessons—objectives, evaluations. I started a new lesson plan each time, but I used what I did before to speed things up.

And:

> Yes, I'm thinking about the evaluation methods to use (here). I did take a lot of time, more time, thinking about what I was doing. I think I said this before. I thought more about what I was trying to teach, how I was teaching, you know, individual kids. My supervisor asked me to think about setting up groups for maths. This is what I'm doing. I tried to find out about groups (pointing to the screen). This helped. It was easy when I saw how to set out a plan for working with groups, so I used it in my lesson (plan). I can see I thought about what I wanted to do more. Yeh, OK. When I was finishing off, I went through the lesson again, here, like the computer said (when using the Reflection tool). It was good. It makes you think, to think about what you've doing, how things fit together. Yeh, (pointing to adding text on screen) I need to think about some of the special children in the class, there are quite a few really intelligent girls.

For all students, there were clear indications provided across the interview data to suggest the 'LPS experience' was a major benefit, in both supporting lesson plan writing directly, and in providing the skills and in particular, the confidence, to tackle lesson planning tasks without the use of the LPS. Furthermore, there were repeated indications in most interviews, that students were aware of the strategies they developed in using the LPS, as well as the benefits they perceived it bestowed. There were also indications of metacognitive skills being developed, of students consciously thinking of their own role in the lesson planning process, and of thinking about the best ways of working with the LPS to produce increasingly better lesson plans.

LESSON PLAN PRODUCTS

All lesson plans created by student–teachers here were subject to grading (F—A) by expert reviewers at Edith Cowan University. For use in providing a graphical representation of data in Figure 3, below, the grades were each articulated to a numerical equivalent (ie. a mark), 1—6 (see Table 2).

Table 2: Articulation of lesson plan assessment: outcome–grade–mark.

Outcome	Grade	Mark
Outstanding	A	6
Outstanding	B	5
Highly Competent	C	4
Highly Competent	D	3
Competent	E	2
Unsatisfactory	F	1

The grades for each of the five students over the series of lesson plans produced by use of the LPS and that were submitted and assessed, show an improvement, at best, of two grades and one major grade category (ie. from Competent to Highly Competent), (students 1, 4); and at worst, of no improvement at all (student 2). However, not all students experienced increasingly positive results in this respect, over the entire span of lesson plans assessed—for some (students 2, 5), their grades fluctuated both up and down, at different junctures in this span (see Table 3).

Table 3: Lesson plan grades [shaded areas indicate lesson plans produced by means of 'pen & paper'].

Lesson plans	Lesson plan grades					
	Student 1	Student 2	Student 3	Student 4	Student 5	Mean (1-5)
L1	2	3	2	2	3	2.4
L2	3	3	3	4	2	3.0
L3	4	4	3	4	4	3.8
L4	4	3	3	4	4	3.6
L5	4	2	3	4	3	3.2
L6	4	3	5	4	4	4.0
L7	5	3				4.0
L8	4	4				4.0
L9	5	3				4.0
Mean (L1-L9)	3.9	3.1	3.2	3.7	3.3	3.4
St. Dev.	0.9	0.6	1.0	0.8	0.8	0.6

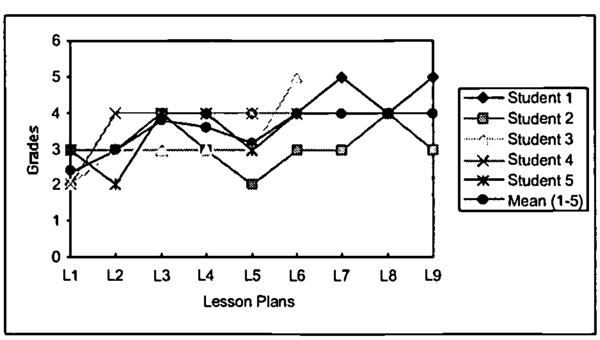

Figure 3: Grades for lesson plans 1—9 (where 1–6 corresponds to F–A).

Any improvement in grades achieved by the student–teachers over the lesson plans produced by use of the LPS, was maintained or bettered in the lesson plans subsequently produced by 'pen & paper' (see Table 3, and Figure 3). In the case of two students (students 1, 3) the improvements were by measures of one major grade category (ie. Highly Competent to Outstanding). Although it is difficult to argue a long–term trend or measure of learning or skill–performance transfer from these figures alone, there is clearly an inference here that some level of transfer did take place. In other words, removing the LPS from the student–teachers here, did not hinder or impair their performance in the lesson planning task; and it is likely, these students transferred their learning and their level of skill–performance in the task, achieved by their use of the LPS, to the same type of task, without the use of the LPS.

CONCLUSION

The study reported here illustrates how novice students used the LPS in a complex task (lesson planning) to reach levels of expertise in the completion of that task; and further, were able to continue to call on this newly acquired skill and knowledge base to complete the same type of task without use of the LPS. Whilst there are a range of cognitive strategies by which novice students developed expertise in their performance of lesson planning, it would seem that all students here benefited in particular from active participation in an holistic, complex yet supporting environment, organised around a single performance goal. In general terms, findings from this study included the following:

(i) Learning and performance in students was transferred substantively across media, so that when the LPS was removed as part of the task environment, learning and skill–performance in the same task continued.
(ii) Not all students learnt or performed effectively in a hypertext environment; and at least one student appeared to be specifically disadvantaged by the embodiment of instructional resources in a hypertext or hypermedia format in the LPS, as a task–based performance environment.
(iii) At least one student in this study was hindered in achieving meaningful and deep learning, by the design of the task environment in the LPS—where learning and performance was intended to be completed simultaneously or at very close proximity, (as in the philosophy of just–in–time learning).
(iv) Learning in a task–focused environment, such as that provided in the LPS, did not appear to promote cognitive strategies in students that were primarily guided by the motivation to perform the task better. Students were just as likely to form strategies guided by the motivation to obtain better understanding in the task.
(v) Students' learning styles or preferences appeared to be the primary factors influencing their adoption of cognitive strategies in learning and performing in a task. This was despite the fact that these strategies were not necessarily suited or optimised to the cognitive tools available for use in the LPS, or to the task–based environment in which they were applied.
(vi) The LPS provided strong cognitive support to novice student–teachers in their completion of lesson planning tasks.

It would seem that whilst PSSs like the LPS, are well–placed for consideration as an alternative instructional model, not all students are in a position to make the best use of them; and that individual learning styles are likely to be a strong determinant of students' success in their use.

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[2] See endnote 1, above.

Influence of Design Decisions on Student Explanations: An Example from *Seeing Through Chemistry*

Tricia Jones (triciaj@umich.edu)
School of Education, University of Michigan, Ann Arbor, MI
Gail P. Baxter (gbaxter@ets.org)
Educational Testing Service, Princeton, NJ

Abstract: We examine the relationship between design features, patterns of use, and the quality of student explanations generated in response to inquiry questions in a multi-faceted hypermedia environment "*Seeing Through Chemistry*." We see that some design features appear to influence student performance. In particular, incorrect answers and a model response seem important for helping students recognize the need to revise. What appears to be lacking are features which lead students to improve the explanation quality as they revise.

1 Introduction

Hypermedia systems may be particularly appropriate as learning environments because the associative knowledge structures of a topic or subject matter are made explicit. However, in creating hypermedia systems, attention must be given to design decisions that can support students in making appropriate connections in their own developing knowledge structures (e.g., McKendree et al 1995). Activities that will highlight the key concepts of a domain and engage the students in problem solving and reflection are especially important in this regard. Examples include guided tours which highlight concepts in a domain and how they are related, multiple possible paths through materials that encourage consideration of the same topics or concepts in differing contexts, questions that promote reflection on the relationships among topics or concepts, and opportunities to revise one's response as understanding develops.

In this paper, we consider the impact of various design features on student learning in a multi-faceted hypermedia environment "*Seeing Through Chemistry*." Psychological principles of learning, in particular, cognitive flexibility theory (Spiro et al. 1988) and principles of human-computer interaction (Dershimer et al. 1992) provided the theoretical and empirical basis for designing the *STC* learning environment. More specifically, *STC* integrates video, animations, and experimental simulations with text and pictures onto multimedia content cards to facilitate the development of students' understanding of topics in an introductory college chemistry course (Dershimer & Rasmussen 1990). Four interaction modes, distinguished by the level of structure and support, focus students' attention on the relationship among topics in each of the six modules and allow for multiple paths through the material to support individual styles and interests.

Inquiry questions form the primary instructional activity in *STC*. The questions represent a synthesis of topics or content cards, and the same topics may be relevant for several questions. Revisiting the same topics (e.g., concentration) in multiple contexts (e.g. pH, precipitation) promotes students' understanding of the relationship among related concepts. Students are asked to respond to the inquiry questions with an answer (select from among two or more choices) and a written explanation. Answers are scored right or wrong and then students are shown a model explanation. The software prompts students to revise their explanations and refer to content cards in that process. However, students are not required to revise their explanations nor does the software evaluate the quality of their explanations. Further, students make decisions on how the software is to be used – whether and when to read the content cards, selection and use of the four navigation modes, and whether and when to revise their explanations. The student makes choices in interacting with the software and it is this interaction that effects the extent of learning, more so than individual design features in the abstract. In what follows, we examine variation in *STC* modules (content cards and inquiry questions), variation in student patterns of use and their relationship to students' explanations to inquiry questions (used as a proxy for student learning or understanding). We conclude with software design implications.

2 Methods

2.1 Study Design

Each of the six modules in *STC* was designed with the same fundamental instructional goal. Nevertheless, characteristics such as the number of topics, content cards, and inquiry questions, and the nature and extent of supporting media influence the options students have to interact with the material. We reasoned that the nature and extent of opportunities to revisit content would influence student learning. To this end, we created visualizations showing which content cards are suggested for each inquiry question in each module and selected two modules that varied widely in coverage (see Figure 1). *Acids & Bases* has 6 inquiry questions, and was the fourth module completed in the semester. *Solubility* has 10 questions, and was the fifth and final module completed.

Acids & Bases
(53% topic coverage)

question	Topics 1-1	1-2	1-3	2-1	2-2	2-3	2-4	3-1	3-2	3-3	4-1	4-2	4-3	5-1	5-2	5-3	5-4
1							•				•	•	•				
2								•	•						•	•	
3									•	•	•		•				
4							•				•		•				
5									•						•	•	
6																	

Solubility
(88% topic coverage)

question	Topics 1-1	1-2	1-3	1-4	2-1	2-2	2-3	3-1	3-2	3-3	4-1	4-2	4-3	5-1	5-2	5-3	5-4
1								•	•	•							
2					•	•		•	•								
3	•				•			•	•	•							
4				•			•		•			•					•
5					•	•	•										
6											•		•	•	•	•	
7											•	•	•			•	
8	•										•	•	•			•	
9				•				•		•				•	•	•	•
10						•			•	•				•		•	•

Figure 1: Coverage in *Acids & Bases* and *Solubility* modules

In Figure 1, bullets (•) indicate when a topic (one or more content cards) is suggested for each inquiry question in a module. Reading across the rows, one can see which topics are suggested for which questions. For example, for *Acids & Bases* question 1, *STC* indicates that topics 2-4, 4-1, 4-2, and 4-3 are relevant to this inquiry question (topics are named in the software, but names have been ignored for the purposes of this discussion).

Complete coverage occurs when each column has at least one bullet (i.e., every topic or content card is suggested at least once). Although neither module has complete coverage, *Solubility* has relatively more coverage than *Acids & Bases*. The columns indicate how many times the topic is visited; more bullets indicate the topic is suggested for more questions (i.e., repeat coverage). Overlap is determined by looking at the pattern of bullets: for example, *Acids & Bases* question 5 covers the same topics as question 2, and only overlaps any other question with one topic (3-2). *Solubility* question 10, on the other hand, overlaps with every other question in the module. Further, the *Solubility* module appears to contain distinct subsets of topics: questions 1 to 5 primarily rely on topics in Clusters 2 and 3, while questions 6 to 8 primarily rely on Clusters 4 and 5. Variety in overlap is important for revealing different facets of the topic; e.g. one question covers saturation and concentration, a second refers to saturation and dynamic equilibrium, while a third relates saturation and solubility.

Note that each module has a different number of inquiry questions and a different number of content cards. Modules with more inquiry questions provide more opportunities to visit a given topic: if there are 10 questions, a student has 10 opportunities to visit any given topic, but if there are only 5 questions, then the student only has 5 opportunities to visit a given topic. To facilitate cross-module comparisons, we report proportional visits: number of potential visits per content card per question. Across the six modules, the *Solubility* module provides the highest number of proportional visits (0.276) and *Acids & Bases* the lowest (0.177).

2.2 Methods, Procedures, and Measures

Participants. This study is part of a larger research project examining the use of *Seeing Through Chemistry* in an introductory chemistry course at a large Midwestern research university. Use of *STC* was required, but participation in the study was not: 201 of the 450 students enrolled in this multi-section lecture course volunteered to participate in the research project by completing additional instruments and giving researchers access to course and background data. Of the 201 participants, 180 completed the modules of interest in this study.

Context. The semester these data were collected, all students used the software regularly, for graded assignments. Students answered the inquiry questions for five of the six modules in *STC* and turned in the printed version of their responses. The printout shows the answer choice and the explanation (initial and final). Teaching assistants checked the assignments for completeness. Students received up to 6 points on each assignment for a maximum possible of 30 points (5% of the overall course grade).

Log Files and Inquiry Question Responses. STC automatically captures the sequence and duration of choices made by the student. This information is recorded to files known as log files, one per student, so that each log file captures completely a student's use of *STC* throughout the semester. The log file also captures transitions and navigation modes, as well as all answers and revisions typed in response to questions.

Explanation Quality. Because *STC* does not evaluate the quality of students' explanations, a post hoc scoring scheme was devised for this purpose, based upon student response data and the content in the model response. A student's explanation is assigned one of five scores, determined by its completeness, coherence, and correctness (cf. Chi, Feltovich, & Glaser 1981). The scores are 0–Inadequate; 1–Fragmented; 2–Partial, 3–Good, and 4–Elaborated. For example, a student who mentions two isolated facts but doesn't relate them to each other or to the question might be given a level 1 score (Fragmented). A student who mentions all the relevant concepts, including an explanation of "mechanism," and who adds ideas not found in the model response would receive a level 4 (Elaborated). The first author scored both initial and final explanations to the inquiry questions. A second rater scored a 25% random sample. Interrater reliability was 0.87 and 0.79 for *Acids & Bases* and *Solubility*, respectively.

Patterns of Use. A variety of software tools derive patterns of use from the participants' log files. Moves are extracted from the log files, and characterized by type (e.g. view question (q), view content card (c), edit response (r)). The sequence of moves is combined and then abstracted to form a pattern label that is assigned to each question.

Interviews with a target group of students (Jones, Berger, & Magnusson 1996) revealed two aspects to patterns of use: base patterns and revision patterns. Base patterns are characterized in two ways: students who look at cards before they read the question and students who look at cards after reading the question but before entering their response. Revision patterns consider whether students revise their explanation and whether students refer to cards between initial and final revision. The possible combinations of base and revision patterns are shown in Table 1. Base and revision patterns of use were identified for each of the 16 inquiry questions for each of the 180 students.

	Revision Patterns			
	do not refer after initial response		refer to cards after initial response	
Base Patterns	no revisions	revisions	no revisions	revisions
qr: read **q**uestion, **r**espond	qr_{init}	$qr_{init}r_{final}$	$qr_{init}c$	$qr_{init}cr_{final}$
cqr: read content **c**ards, read **q**uestion, **r**espond	cqr_{init}	$cqr_{init}r_{final}$	$cqr_{init}c$	$cqr_{init}cr_{final}$
qcr: read **q**uestion, read content **c**ards, **r**espond	qcr_{init}	$qcr_{init}r_{final}$	$qcr_{init}c$	$qcr_{init}cr_{final}$
cqcr: read content **c**ards, read **q**uestion, read content **c**ards, **r**espond	$cqcr_{init}$	$cqcr_{init}r_{final}$	$cqcr_{init}c$	$cqcr_{init}cr_{final}$

Table 1: Patterns of Use in *Seeing Through Chemistry*

Intuitively, we expect those who read the content cards to write better explanations. On the other hand, perhaps some students do not read the cards prior to responding if they think they already know the material. They may intend for the exercise to serve as a "self check" on their understanding; if they determine they don't understand, they will read further. Students may read the cards before they answer the question, or after they read the questions but before responding. The former is like reading the chapter before doing the exercises; the latter is like pre-reading questions on a reading comprehension test. Both are legitimate strategies, but one may be more effective in this setting.

3 Results

We believe that the design of instructional software can greatly influence the learning that occurs, through the nature and quality of the interaction that is supported. Because the design of the *Solubility* module is more robust and interconnected with respect to topic coverage than is *Acids & Bases*, we expected students to provide higher quality explanations for that module. In analyzing student responses, we first considered the answer choices and the explanation quality. We further examined these measures in light of the process students undergo while answering inquiry questions, both what they do before making their initial response (base patterns of use) and what they do while working towards their final revision (revision patterns of use).

3.1 Answer Choices and Explanation Quality

In analyzing student responses, we first considered answer choices. In general, the answer choices to inquiry questions were relatively easy for students: for 4 of the 6 questions in *Acids & Bases*, 80% or more of the students made the correct choice. The most difficult question in this module was Question 4, with only 20% initially correct. The *Solubility* module is similar in the sense that the questions were relatively easy for students to get correct on their first response. However, there was less variation in the difficulty of the inquiry questions. For all of the *Solubility* questions, 55% or more of the students answered correctly, and for 7 of the 10 *Solubility* questions, 80% or more of the students made the correct choice initially. Furthermore, in *Acids & Bases*, 146 students (~81%) got more than half the questions initially correct, while in *Solubility*, 174 students (96%) got more than half the questions initially correct.

	Acids & Bases Module (6 questions)						Solubility Module (10 questions)					
	Answer Correctness		Explanation Score Totals (max possible = 24)				Answer Correctness		Explanation Score Totals (max possible = 40)			
Response	min	max	M	SD	min	max	min	max	M	SD	min	max
Initial	20%	95%	7.34	(3.97)	0	17	57 %	97 %	12.01	(6.13)	0	34
Final	100%	100%	12.84	(3.68)	4	21	100 %	100 %	19.06	(6.44)	6	36

Table 2: Answer and Explanation Scores (n=180)

Explanations were scored on a 4-point scale. As shown in Table 2, in the *Acids & Bases* module, students average around 1 (fragmented) point per question for initial responses and move to a 2 (partial). Likewise for the *Solubility* module, students improve from an average score just above 1 to just below 2. In both modules we see that students generally select the correct answer choice but they do not provide high quality explanations for their choices. Moreover, students do revise their explanations and the change in the quality of explanations is statistically significant ($t(df=179)=18.65$*** and $t(df=179)=15.40$*** for *AB* and *Sol*, respectively) but the magnitude of the difference is small. Furthermore, contrary to expectations, there were no obvious differences between the two modules in overall quality.

3.2 Base Patterns of Use

In examining students' patterns of use we asked: do patterns of use affect explanation quality? To answer this question we characterize the various patterns of use and the consistency with which students use them within and between modules. In *Acids & Bases*, 119 students use only one of the four base patterns, a further 31 use one pattern for five of the six questions; therefore, 150 students (83.3%) use a single pattern almost exclusively. Similarly, in *Solubility*, 139 students use one pattern exclusively, while 19 more use one pattern for all but one question. So 158 (88%) use one pattern almost exclusively. Furthermore, only 20 students (11%) switched from a 'cards first' (cqr or cqcr) pattern to a 'questions first' (qr or qcr) pattern between the two modules.

In both modules, the qcr pattern is used by almost half the 180 students on each question, but the distribution of students amongst the other patterns varies considerably across questions. Furthermore, students are either in a 'cards first' group (cqr and cqcr) or a 'questions first' group (qr and qcr). However, the distribution of students within these pairs changes through the module. Finally, as the module progresses, students tend to refer to cards between the question and the response (e.g. the size of the qr group decreases while qcr increases, likewise for cqr and cqcr).

	qr		cqr		qcr		cqcr		sample			
question	M	(sd)	M	(sd)	M	(sd)	M	(sd)	M	(sd)	F	group differences
AB q1	0.98	(1.11)	1.87	(1.19)	1.81	(1.03)	2.24	(1.37)	1.65	(1.21)	8.47 *	qr < cqr, qcr, cqcr
Sol q2	1.02	(1.22)	1.66	(1.26)	0.62	(1.02)	1.73	(1.32)	1.12	(1.25)	9.58 *	qcr < cqr, cqcr
Sol q5	0.83	(1.29)	1.59	(1.30)	0.96	(1.06)	1.66	(1.14)	1.18	(1.22)	4.99 *	
Sol q7	0.87	(0.97)	2.06	(0.89)	1.70	(0.90)	1.85	(0.94)	1.69	(0.97)	8.43 *	qr < cqr, qcr, cqcr
Sol q10	0.43	(0.99)	1.24	(1.16)	0.90	(0.86)	1.17	(0.95)	0.96	(0.98)	3.95 *	qr < cqcr, cqr

* $p < .003$ (.05 / 16)

Table 3: Initial Explanation Quality Score by Base Pattern Group

In order to examine effectiveness of strategies, we examined mean scores within the base pattern groups. Initial explanation quality score means and standard deviations are shown in Table 3 (only significant results are shown, due to space restrictions). On each of the 16 questions, we conducted a within-subjects (base pattern group: qr vs. cqr vs. qcr vs. cqcr) ANOVA. Base pattern group effects were significant for 5 of the 16 questions. For 4 of these 5, significant group mean differences were found. For two questions (AB1, Sol 7), the qr group had lower mean scores than all other groups. For a third question (Sol 10), the qr group had lower scores than the two cards-first groups (cqcr and cqr). Consistent with our expectations, these results suggest that patterns of use are related to performance. Students who read cards (either before the question or between the question and response) generate better quality explanations than students who don't read cards prior to writing their response.

3.3 Revision Patterns

Students are asked to respond to each inquiry question by selecting an answer from among the choices given and generating an explanation to support their choice. Recall that students can then revise their explanations. Do they use this opportunity? What features might influence their decision? Do their revisions lead to improvement?

We examined whether students consistently applied revision patterns. In *Acids & Bases*, 20 students only use one of the four revision patterns, a further 28 students use one pattern all but once; therefore, only 48 students (26.7%) use a single pattern almost exclusively. Similarly for *Solubility*, 10 students use one pattern exclusively, while 25 more use one pattern for all but one question. Thus, only 35 students (19.4%) use a pattern almost exclusively in *Solubility*. Contrast this with the base patterns of use where the values were 83% and 88%. Base patterns are fairly consistent and revision patterns are less so. This suggests that the base pattern is perhaps more characteristic of the student, while the tendency to revise or refer is more a reflection on the design features of the software.

What software features might influence the quality or the revision process itself? We reasoned that feedback on performance would be an important determinant of students' performance. To examine this, we looked at the percentages who revise, and whether those revisions improve the explanation quality. Students are given feedback as to the correctness of their answer, but they are not given explicit feedback about the quality of their explanation. However, if their answer is correct, they are shown a "model" response or explanation to which they can compare their explanation as an indicator of quality. If the answer is incorrect, students are prompted to review relevant content cards; a "model" explanation is not shown. Students then made a decision—not imposed by the software—about whether and how much to revise their explanation, and whether to refer to cards.

3.3.1 Answer Correctness and Tendency to Revise

We expected students to revise their explanations when they provided an incorrect answer and as expected the questions that were the most difficult (i.e., the largest number of incorrect answers) had the highest number of explanation revisions. Virtually all students with a wrong answer revised their explanation. However, we also found that 20 to 60% of the students with a correct answer (depending on the question) revised their explanations. This finding suggests that students use criteria other than correctness of answer to judge whether to revise their explanation.

3.3.2 Model Response and Explanation Quality

One possibility is that students compare their explanation to the model response. As it turns out, one of the inquiry questions did not have a model response. An examination of responses to *Sol* q3 shows that the question was slightly more difficult than average; 80% of the students answered correctly. While all students with incorrect answers revised, only 20% of the students with correct answers revised. This is the lowest percentage of all the questions.

Why do students revise? Perhaps their explanations are quite bad, and their revisions only bring them up to the quality of those who don't revise. Furthermore, revising does not guarantee improvement; however, the data reveal that revisers tend to improve the quality of their explanations, although slightly less so in *Solubility* than in *Acids & Bases* (75% and 80% for *Solubility* and *Acids & Bases*, respectively). If we examine only those students who revise, the scores for explanations increase on average by about 1.5 points (on a 4-point scale). Their final scores are typically between 2 and 2.5, which is higher than the overall mean.

In both modules, there is one question where improvement is much less common. For *Solubility* question 3, only 42% of the revisers received a higher score. In contrast, 72% or more of the revisers improved their scores for all other questions in that module. Again, *Solubility* question 3 did not have a model response – this perhaps suggests that many students rely on the model response in their revisions. In *Acids & Bases*, 43% of the revisers on question 5 do not see an improvement. The reason is not immediately obvious, but it might be that students were unable to pick out the crucial concepts in the model response and instead latched onto surface differences.

4 Conclusions

We see that some design features appear to influence student performance. In particular, incorrect answers and the model response seem important for helping students recognize the need to revise. What appears to be lacking are features which lead students to improve their explanation quality as they revise. Furthermore, differences in coverage do not appear to influence explanation quality or revisions. Perhaps this is because students do not refer to much content in the first place, so any potential benefit from a more well-connected module is mitigated.

According to the *STC* designers, revision should be a key process when students answer the inquiry questions (Dershimer et al. 1992). Substantial revision in the sense of improved explanations is not taking place. Why not? We see that students revise when the inquiry question choice is hard (when they choose the wrong answer). Perhaps the questions need to be harder or trickier. But also, the nature of the interaction – merely expecting students to revise – does not seem to encourage engagement. Students need feedback on the quality of their explanations. A different response model can be seen in the Evolutionary Thematic Explorer (Jacobson 1997). In that system, students choose statements from a list and then have their answers critiqued with respect to two major theories of evolution. Experimental results show learning occurred. Perhaps similar activities here would help: students could assemble an explanation from sets of statements that either capture key concepts or highlight common misconceptions.

Furthermore, students need an incentive to revise. While the inquiry questions were used here as the primary instructional activity, they are in one sense just another navigation mode. Students are supposed to choose the mode that best helps them learn. Discussions with the primary designer indicate that reliance on inquiry questions might best be used in a classroom where considerable discussion takes place before the final explanation is written (Dershimer 1996). At a minimum, if these questions are to be used as an assignment, the graders need to pay attention to whether or not and what kinds of revisions students make. Without the external motivation of a grade that takes explanations into account, many students will not make the effort to learn the material or to express their understanding.

Our experience identifying the extent of criss-crossing would be a useful exercise for hypermedia designers. Visualizations such as we created can help identify the gaps in coverage at the design stage, rather than in a later analysis. When we began this study, we thought "criss-crossing" referred to the content design: are the content cards related and cross-linked? do the inquiry questions lead students to visit all the cards? But what we see instead is that the design of the questions itself – are they hard? do they reveal common misconceptions? – seems to have considerable influence over whether or not students make substantial changes in their explanations.

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Learning Engines, a Component Framework for Rich Online Learning Activities

Paul Fritze
Multimedia Education Unit
The University of Melbourne, Vic, Australia
p.fritze@meu.unimelb.edu.au

Gangmeng Ji
Multimedia Education Unit
The University of Melbourne, Vic, Australia
g.ji@meu.unimelb.edu.au

Abstract: A component framework for implementing Web-based learning activities, customisable for local discipline and teaching requirements, is proposed. The framework is based on a standard protocol for describing and recording the state of Web pages containing arbitrary arrangements of HTML input elements and/or interactive objects constructed in JavaScript, Shockwave or Java. The State Description Protocol lays the foundations for independent development and reuse of software components with which learner activity can be recorded, analysed and re-created. Learning activity pages may contain embedded references to previous tasks and provide conditional feedback to student input by way of additional components. The framework philosophy is to provide flexibility in educational design, multiple paths to adoption and to maximise collaborative sharing and reuse of both components & pedagogical techniques.

Background

The Multimedia Education Unit is a central academic unit supporting the University in its move to integrate technologies into 'transformed' curricula. It provides educational design, evaluation, media & programming services and runs staff development programs. The Unit is involved in the development of a range of faculty projects where local academic knowledge is the key to understanding learning and discipline requirements. The Unit has a central role in recognising, developing and promoting techniques that will facilitate effective utilisation and transfer of this expertise throughout the institution and further afield.

Educational technology is increasingly being focussed on the more open, flexible and apparently democratic world of the Internet. This move is not without its difficulties, given the wide range of possible solutions, the rapid evolution of technologies and challenges to individuals adjusting to new skills and roles. Finding a path through a complex and dynamic solution space involves broad consideration of educational, organisational, technical and individual needs. Integrated course systems such as WebCT and TopClass provide useful tools and templates for efficient management of learning and production of materials. In the process however, they also restrict flexibility of approach, for example in the use of customised discipline interfaces or in the richness of conditional feedback. The model proposed is intended to supplement the capacities of such integrated systems.

Customised Learning Activity Scenarios

We have tried to address the need for high quality interactive learning while ensuring that both software and pedagogical techniques are scalable and transferable. Educational requirements targeted include the capacity to support:

- *customisable user interfaces* to discipline knowledge;
- *responsive feedback* to a student's actions;

- exercises involving with *subjective knowledge*;
- customisable learning sequences that can incorporate *elements of face to face interaction;* and
- *reflective summaries and overviews of the learning experience* for both student and teacher.

Such requirements are derived from the experiences gained working with faculty teaching staff on real course projects. For example, a structured learning sequence might be proposed by a teacher as a useful exercise for students in a particular content area. Scenarios such as this from different discipline areas are of prime relevance to the formation of a generic implementation framework. More detailed ones have been described (Fritze, Johnston & Kemm 1998). It is the teacher's understanding of student, content and teaching strategy, predating technical implementation considerations, that we are keen to harness.

This scenario illustrates how a simple sequence of learning actions might take place between a student (S) and mentor (M). It represents one approach of a teacher in a face to face tutorial, seeking to encourage reflective thinking.

1) S is presented with an issue and asked to articulate an initial interpretation
2) M suggests one relevant factor and asks S assess their own response to that criterion.
3) M provides feedback based on this assessment (2 & 3 are repeated with different criteria)
4) M then recalls the initial view and asks S to re-examine this initial interpretation.
5) S receives a summary overview of key points, demonstrating how their initial interpretation has developed.

The learning sequence is expanded (Fig. 1). If such an activity were to be facilitated, not by face to face communication, but by an online computer, simple text entry fields and check buttons are probably adequate for articulation of responses 1a, 2a & 4a. A sequence of disconnected questions however, would not be sufficient to capture the full spirit of the dialogue. For example, analysis of the response 2a is necessary for useful feedback (3). In addition, the initial hypothesis is recalled in later tasks (2 & 4) and again in the summary overview (5). Knowledge of the student's actual efforts needs to be maintained for the life of the activity and could possibly be referred to in entirely different contexts in other areas of a course (6).

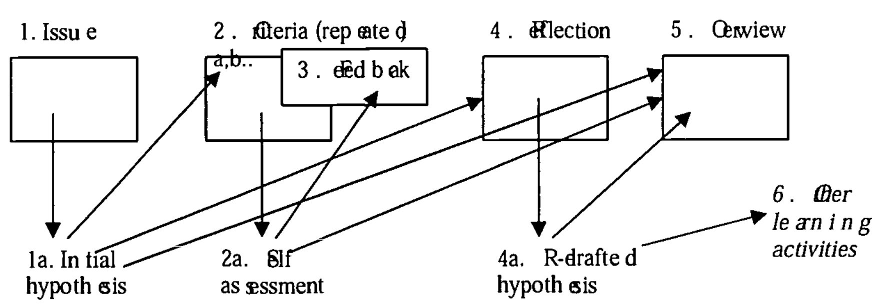

Figure 1: Stages of a reflective learning sequence 1-5. Student entries 1a, 2a, 4a are re-introduced to later tasks

This example represents a relatively simple face to face dialogue interaction to which many variations and extensions possible. We desire to construct such sequences within a practical online environment.

A Component Framework to Support Customised Learning Interactions

A component architecture to facilitate synthesis of online learning scenarios of the type above is illustrated (Fig. 2). This has evolved from an earlier work (Fritze & Ip 1998) in which a central 'activity manager' object running in the browser controlled the entire process. The new modular architecture has enabled the integration of components and techniques from other projects, for example the Virtual Apparatus framework (Ip et al. 1997) and Component-based Object Library (Ji et al. 1998). Web pages can now be light in weight, with simpler, easier to maintain software. Additional components can be created in whatever technology is appropriate.

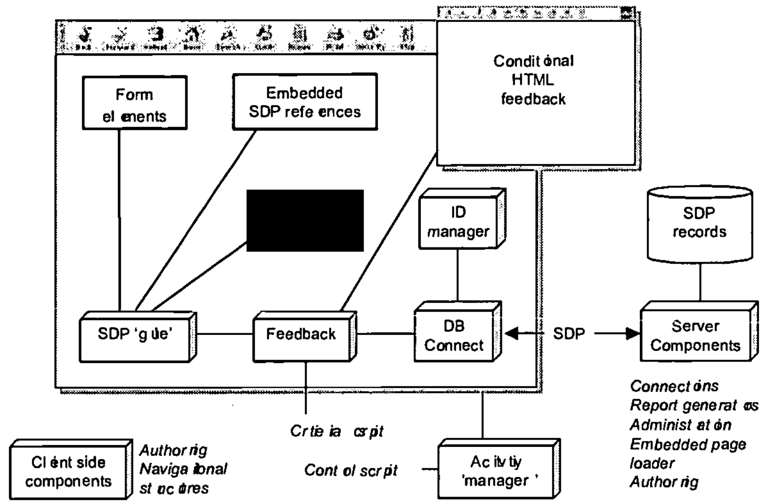

Figure 2: Learning Engines components and protocol framework.

A browser page contains visible user interface components such as forms elements and interactive Java or Shockwave objects. These are connected by a common State Description Protocol representing the state of the page as described below. SDP conforming components are supported by a 'glue' script and linked to a database via other components. Additional functions can be added to provide specialised feedback or management of page sequences, for example. Various page configurations are indicated (Tab. 1) with those required in the described learning sequence (Fig. 1) numbered.

Page Style	SDP glue	Interactive I/F object	DB/ID connect.	Feedback Comp.	Embedded SDP refs	Notes
Resource page	R	o				Page containing HTML form elements and/or interactive objects can be set to particular states on loading or by clicking different HTML buttons.
Basic saved page (1)	R	o	R			Page state is saved to and retrieved from a corresponding record in database.
Conditional feedback (2)	R	o	o	R		A feedback component analyses and responds to page state according to criteria statements.
Embedded SDP References (2, 5)	o	o	o	o	R	Page containing embedded references to SDP records of any activity. Rendered by a loader component as a summary document, activity map, progress log etc.
Redrafting task (4)	R	o	R	o	R	Previously submitted SDP entry inserted into a new task for redrafting.

Table 1: Possible configurations of page components for different learning purposes. Each page requires certain components (R), others are optional (o). Numbers in brackets refer to page structures used in figure 1.

Interface Components

In addition to HTML text fields, radio buttons, checkboxes, popup menus , framework Web pages may contain interactive objects developed in JavaScript, Shockwave or Java. For example, a large number of specialised components have been written in dynamic HTML for an online course in Chinese language (Ji et al. 1998). A Shockwave object for graph sketching is illustrated here (Fig. 3) and others have been described (Fritze & McTigue 1997). The essential characteristics for such interactive objects are that they:

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- operate within a browser page supported by basic 'glue' scripts;
- register their current State Description to the controlling page in response to student actions; and
- can configure themselves to a certain State Description if instructed by the controlling page.

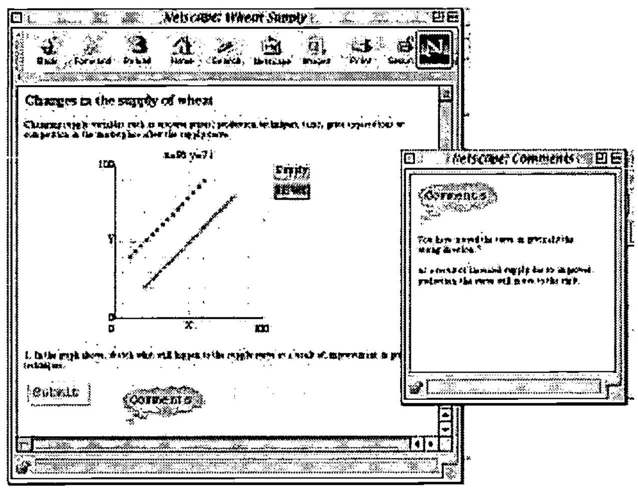

Figure 3: A Shockwave graphing object and assessment component combined on framework page to provide conditional feedback based on the State Description of an entered graph.

Representation of State – the State Description Protocol

The central element of the Learning Engines framework is the ability to record a snapshot of a learning activity page containing any combination of forms elements or conforming external interface objects. This is specified in terms of a State Description Protocol (SDP) that can be used to record the student entries, restore previous page states and for analysis of students input. The SDP is a 'list of lists' consisting of property/value pairs, where a value may be a string, a number or another list as in the following form:

{prop1:value1, prop2: {subprop1:value3, subprop2:value4 }}

The SDP syntax relates closely to object structure representations in both JavaScript and Director Lingo as well as to the pedagogical learning elements. Not immediately obvious is that the SDP string format requires no special database configuration for different page configurations and rich descriptions of the customised pages and embedded objects can be readily defined. For example, the SDP for the above page (Fig. 3) containing a single 'graph' object set with one curve supplied by the question ('supply') and another entered by the student ('answer') is:

{graph:{supply:{style:"growthline", X1:20, Y1:20, th1:40, th2:220, X2:80, Y2:70},
answer:{style:"growthline", X1:10, Y1:40, th1:45, th2:225, X2:60, Y2:90}}}

Assessment and Feedback Components

The use of SDP facilitates analysis of a student's input and formulation of appropriate responses. The SDP string above contains detailed information with which to interpret the curve entered by the student (Fig. 3). The 'Submit' assessment component on the illustrated page (Fig. 3) has established that the style of the curve 'answer' is correct (graph.answer.style = 'growthline'), its gradient is correct (graph.answer.th1 = 45), but that its coordinates place it incorrectly.

A number of feedback components have been developed, ranging from very simple JavaScript functions that compare the SDP of a page with a preset value, to one controlled by an XML criteria specification to progressively reveal feedback comments and provide access to further tasks. Further feedback mechanisms can be developed as required for particular purposes.

Embedded SDP References

The learning sequence (Fig. 1) requires that page states be carried forward into other pages. This is achieved by embedding references to the stored SDPs within the HTML of a page. When displayed by a loader component, these references are expanded with the latest state information from the corresponding database SDP record. In this example the overview page (5) refers to text entered as the initial hypothesis 1a, as well as to the self-assessments 2a and the redrafted entry in 4a. The embedded reference could be contain text, HTML, or even the state of an interactive object such as the curve entered in a graph sketcher above. This capacity to refer to any element of work submitted makes possible a range of useful learning functions, such as progress reports, entries in learning 'journals', summaries of key points or dynamic content maps. Such a page could serve multiple purposes such as an overview of the issues and a navigational menu (Fig. 4).

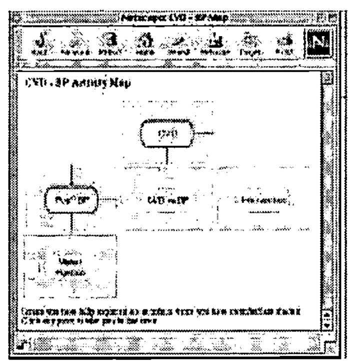

Figure 4: A map page representing the progress of a student as a 'jigsaw'. Each piece is an embedded reference to the SDP of an exercise page and is filled in as the student completes the activity. The pieces contain links to the relevant activity.

Conclusion

We have attempted to relate closely to coal-face educational requirements in building the foundations of a framework for customised on-line learning interactions. Such requirements relate at least in part to the features of face to face dialogue. Central to the pedagogical and technical operation is a protocol for memorising and analysing the states of Web pages containing an arbitrary arrangement of input elements or interactive objects. These records of student activity are accessible from any other page, enabling the construction of simple but useful learning structures.

Since the initial writing of this paper, the Learning Engines framework has been incorporated into OCCA, an Online Courseware Component Architecture under development at the Multimedia Education Unit. OCCA formally brings this work together with other online technologies developed at MEU: the Virtual Apparatus framework (Ip et al. 1997) and Component-based Object Library (Ji et al. 1998). During 1999, over a dozen internally funded University projects will use this architecture. Work in MEU will concentrate on facilitating the direct involvement of Faculty academics in the production of materials. This will involve collation of exemplars of interactive question configurations, the running of workshops and the evaluation of techniques developed.

While online interactions do not replace face to face dialogue, they can usefully supplement and enhance other approaches to teaching and learning. The flexibility offered by the framework can empower academics to think beyond what might be offered by more rigid delivery methods, for example, by integrated courseware systems and traditional lecture/tutorial environments. The intention is to encourage conception of novel learning interfaces and interactions that will operate in conjunction with other such approaches. It is hoped that the uptake of OCCA into the University and wider community will provide a productive environment in which components and learning techniques can be developed and shared.

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MULTIMEDIA INTERFACE DESIGN IN RELATION TO A LEARNER'S CULTURE

Ahmed AlHunaiyyan*, Jill Hewitt**, Sara Jones***
University of Hertfordshire
Faculty of Engineering and Information Sciences, Computer Science Dept.
College Lane, Hatfield, Hertfordshire. AL10 9AB, UK.
Tel.: 00441(707)284321 Fax: 00441(707)284303
Emails: * a.al-hunaiyyan@herts.ac.uk, ** J.a.hewitt@herts.ac.uk
*** s.jones@herts.ac.uk

David Messer
University of Hertfordshire
Faculty of Human Sciences, Psychology Department
College Lane, Hatfield, Hertfordshire. AL10 9AB, UK
Tel.: 00441(707)284622 Fax: 00441(707)285073
Emails: d.j.messer@herts.ac.uk

Abstract: This paper discusses cultural factors in user acceptance of human-computer interfaces and presents findings from the first phase of the development and evaluation of two versions of a multimedia program *"Learn About PCs"* (British version and Kuwaiti version).

The purpose of this study is to evaluate users' perceptions and opinions about two versions of *Learn About PCs*, its usability and suitability to the users' culture, highlighting some issues which designers may consider when designing multimedia programs for different cultures. The study was able to uncover several interesting findings and to make recommendations which are useful for redesigning the two versions of *Learn About PCs* . The overall results of this study confirm that most of Kuwaiti students preferred the Kuwaiti version of the multimedia program while most of British students, British experts, and Kuwaiti experts preferred the British version of the program compared to the Kuwaiti one.

1.0 INTRODUCTION

It is believed that culture is a discernible variable in interface acceptance, and that interfaces should be designed to accommodate users' culture (Del Galdo 1996, Fernandes 1995, Uren et al 1993, Nielsen 1990). Since there has been little research in the area of designing multimedia learning programs for different cultures, this study is intended to underline and see where the issues lie and how they might be investigated.

Two versions of *Learn About PCs,* a multimedia learning program, have been designed, one for British and one for Kuwaiti Higher Education (HE) students. They carry the same content and structure, but they are different in the way that media elements are presented on the screen. The two versions have been designed and developed not only to look at how the interface worked and how successful it was, but also to examine some presentation and screen design differences which accommodate both the British and Kuwaiti users. The program does not give a detailed knowledge about computers, but rather provides learners with all-round grounding in the concepts involved which serves the intended outcome of the study. The objectives of this study are as follows:

1- To identify some presentation design issues when developing multimedia programs for different cultures.

2- To evaluate the usability and the suitability of the two versions of *Learn About PCs* for the British and Kuwaiti HE students, and to provide some recommendations for future designs.

2.0 THE DESIGN OF *"LEARN ABOUT PCs"*

Learn About PCs was designed and authored using *Asymetrix Multimedia Toolbook version 4.0.* The process for designing the program were identified as information design *(defining the content and the audience),* interaction design *(defining the navigation, types of interaction, and control),* and presentation design *(defining the style and the layout of the elements).* Theories and issues which contribute to an effective interface design were taken into account, such as: ease of use, consistency, visual representations, etc. The prototype of *Learn About PCs* was originally designed to suit British HE students. The design intentionally followed a set of theories and guidelincs outlined in the British literature (Boyle 1997, Vossen et al 1997, McAtter and Shaw 1995, Davies et al 1994, Leonard 1994, Preece 1990).

3.0 DESIGNING THE KUWAITI VERSION

In order to achieve the objectives of this study as outlined in the introduction part of this paper, the initial program *(British version)* was redesigned producing a version of the program which suits Kuwaiti HE students *(Kuwaiti version).* Since there is not much work published about designing multimedia interfaces for Kuwaiti or Arabic cultures, the researchers have identified some presentation design differences based on their investigations and their knowledge about the Kuwaiti and British cultures. Some differences were identified as: *Buttons and icons, Background Colours, Frames and Borders, Graphics, Music, and Speech.* Based on these differences, *Learn About PCs* was redesigned while other issues such as: content *(in English language),* structure, functionality, navigation links, and screen layout were kept the same.

4.0 METHODOLOGY

The procedure followed in the evaluation of *Learn About PCs* consisted of various phases which have been identified by (Catenazzi et al 1997). These phases are: *Selecting the technique; Preparing the evaluation; Conducting the evaluation; and Elaborating data.*

4.1 SELECTING THE EVALUATION TECHNIQUE

The first step of *Learn About PCs* evaluation was the choice of the most appropriate evaluation technique, taking into account the stage of development of the prototype and the research context constraints. It was believed that the most suitable way for evaluating the program was a limited survey technique, in which a semi-structured interview was used.

4.2 PREPARING THE EVALUATION

The preparation of the evaluation involved *selecting the participants; arranging the semi-structured interview; and defining the tasks* which are necessary to obtain feedback from the participants.

4.2.1 PARTICIPANTS

With respect to the selection of the evaluators, the researchers took into account the *Learn About PCs* evaluation objectives, that is to verify that the two versions of the program are suitable for the users' culture. Therefore, two groups of potential users were required (Experts and Students). Seventeen experts *(6 British and 11 Kuwaiti)* and nine HE students *(4 British and 5 Kuwaiti HE students).*

4.2.2 INTERVIEW

The semi-structured interview was arranged to elicit evaluators' opinions with the aim of assessing the usability and suitability of the two versions. The interview form was divided into four parts: Part One was concerned with participants' personal information; Part Two was concerned with common design issues and the usability of the program; Part Three sought evaluators' opinions about the differences between the two versions of *Learn About PCs* and their suitability to their culture; and Part Four was concerned with evaluators opinions about the preferred version and their general comments and suggestions for improvements.

4.2.3 TASKS

With respect to the task selection, taking into account the objectives of the study, users were asked to navigate and interact with the two versions of *Learn About PCs* by turning pages, activating links, playing media, etc. insuring that they went through and interacted with the whole program. They were asked to observe the differences between the two versions which were identified in section 3.0. It took about one hour to complete all of these tasks. It was considered useful to have their comments and opinions about the program's usability, utility, and suitability directly, by asking them a number of questions while they were interacting and recording their feedback immediately before the semi-structured interview which was planned to be accomplished after completing the tasks at the end of each session.

4.3 CONDUCTING THE EVALUATION

After the preparation had been completed, the evaluation process started. The evaluation took place both in Kuwait *(Kuwaiti experts and students),* and in Britain *(British experts and students).* Subjects were informed that they are not being tested, rather it is the system that is being tested. The evaluation execution was conducted individually, that is, one user at a time in order to follow and observe them during their interaction, stopping them when needed, asking questions, and taking notes about their comments and suggestions. The evaluation process lasted between one hour and one hour and a half including the task and the interview at the end of the session. The evaluation time varied, that is because some evaluators were interested in the program, giving more comments and suggestions and raising many questions, while others, *(mainly students),* were strictly accomplishing the tasks, and finally answering the interview questions, giving some comments and recommendations.

4.4 ELABORATING DATA

The data produced were elaborated, in order to transform them into findings and recommendations for improvement. The evaluation results are reported in the following section.

5.0 RESULTS

Significant differences were found between evaluators opinions about the two versions of the multimedia program. The results of the evaluation are summarised in (Tab. 1) through (Tab. 8). Note that the scale used for (Tab. 1) is represented by *(Scale: 5 = very much and 1 = not at all).*

Questions	Kuwaiti Students	British Students	Kuwaiti Experts	British Experts	Average
1-Are buttons and icons in the British version meaningful?	3.8	4.5	4.1	4.3	***4.2***
2-Are buttons and icons in the Kuwait version meaningful?	2.9	3.4	2.7	2.9	***3.0***
3- Did you like background colours in British version?	3.8	3.5	3.4	4.2	***3.7***
4- Did you like background colours in Kuwaiti version?	3.6	3.5	3.3	2.8	***3.3***
5- Did you find frames and borders in the British version appealing?	3.8	3.8	3.4	4.0	***3.8***
6-Did you find frames and borders in the Kuwait version appealing?	4.0	3.5	3.1	2.8	***3.4***
7- Did graphics and images in the British version reflect British culture?	4.0	3.3	4.2	4.0	***3.9***
8- Did graphics and images in the Kuwaiti version reflect Kuwaiti culture?	4.0	3.8	3.9	4.0	***3.9***
9- Did you notice the differences in "graphics" in the two versions?	4.4	3.8	4.1	4.3	***4.2***
10- Is music appropriate in the British version?	4.0	3.3	3.7	3.0	***3.5***
11- Is music appropriate in the Kuwaiti version?	3.8	3.3	4.0	3.5	***3.7***
12- Is speech appropriate in the British version?	4.2	3.8	4.3	4.5	***4.2***
13- Is speech appropriate in the Kuwaiti version?	4.8	3.5	4.0	3.5	***4.0***

Table 1: Differences in Design: (Buttons and icons, background colour, frames, graphics, music, and speech)

	British Version	Kuwaiti Version	Both Versions	None
British Students	75%	25%	0%	0%
Kuwaiti Students	60%	40%	0%	0%
British Experts	66.5%	25%	8.5%	0%
Kuwaiti Experts	95.5%	4.5%	0%	0%

Table 2: Which version did you prefer with regard to buttons and icons?

	British Version	Kuwaiti Version	Both Versions	None
British Students	25%	50%	25%	0%
Kuwaiti Students	40%	40%	20%	0%
British Experts	67%	0%	16.5%	16.5%
Kuwaiti Experts	45.5%	27%	18%	9%

Table 3: Which version did you prefer with regard to background colours?

	British Version	Kuwaiti Version	Both Versions	None
British Students	50%	25%	25%	0%
Kuwaiti Students	0%	60%	40%	0%
British Experts	67%	33%	0%	0%
Kuwaiti Experts	36%	55%	9%	0%

Table 4: Which version did you prefer with regard to the use of frames?

	British Version	Kuwaiti Version	Both Versions	None
British Students	50%	0%	25%	25%
Kuwaiti Students	20%	80%	0%	0%
British Experts	50%	0%	50%	0%
Kuwaiti Experts	18%	45.5%	36%	0%

Table 5: Which version did you prefer with regard to graphics and images?

	British Version	Kuwaiti Version	Both Versions	None
British Students	50%	50%	0%	0%
Kuwaiti Students	20%	80%	0%	0%
British Experts	33%	33%	17%	17%
Kuwaiti Experts	0%	64%	18%	18%

Table 6: Which version did you prefer with regard to music?

	British Version	Kuwaiti Version	Both Versions	None
British Students	75%	25%	0%	0%
Kuwaiti Students	0%	100%	0%	0%
British Experts	83%	0%	17%	0%
Kuwaiti Experts	45.5%	45.5%	9%	0%

Table 7: Which version did you prefer with regard to speech?

	British Version	Kuwaiti Version	Both Versions	None
British Students	75%	25%	0%	0%
Kuwaiti Students	0%	40%	60%	0%
British Experts	67%	16.5%	16.5%	0%
Kuwaiti Experts	54.5%	27.3%	18.2%	0%

Table 8: In General, Which version did you prefer, British or Kuwaiti?

6.0 DISCUSSIONS

This study was able to uncover several interesting findings and to make recommendations to designers when designing multimedia programs for different cultures. The overall results, as shown in (Tab. 8), confirm that most of the Kuwaiti students, taking their comments and suggestions into account, preferred the Kuwaiti version of the program while most of the British students preferred the British version. In addition, most of the British and Kuwaiti experts preferred the British version of the program stating that "It has a standard and simple look and feel" compared to the Kuwaiti one. The following is an interpretation of the tables shown above.

6.1 BUTTONS AND ICONS

As shown in (Tab. 2), participants were more positive about buttons and icons in the British version than the Kuwaiti version, mainly because they believe that buttons and icons are more simple and clear. (Tab. 1) reveals that the average score of participants' opinions about buttons and icons in the British version is 4.2, while in the Kuwaiti version is 3.0. Out of evaluators' responses, it is learnt that it is essential to improve buttons and icons in both versions with emphasis on placing drawn graphic icons *(rather than the bitmaped icons)* for the Kuwaiti version keeping them as simple and standard as possible, and design them to better reflect the Kuwaiti culture.

6.2 BACKGROUNDS AND COLOURS

The dominant background in the British version is textured grey as suggested by (Boyle 1997), and for the Kuwaiti version is textured dark brown, as it is the norm for most of the Kuwaiti Press which represents the Kuwaiti desert environment. As shown in (Tab. 1), the average score for background colour in the British version is 3.7 while for the Kuwaiti version is 3.3. (Tab. 3) reveals that British and Kuwaiti students have similar degree in liking background colours for both versions, while British and Kuwaiti experts were clearly positive about background colour in the British version.

Although the use of colours can carry different meanings for different cultures, there have been, as noticed from participants comments, a lot of contradictions which indicates that colours should not be a cultural issue, but rather a personal taste when developing multimedia programs. In addition, background colours should fit with the domain which the application covers.

6.3 FRAMES AND BORDERS

The British version was designed with normal borders which were represented by lines around both the main screen and the information area. However in the Kuwaiti version, two Islamic frames *(borders)* were used, one around the screen, and one around the information area. The objective of the use of frames in the Kuwaiti version was to add Kuwaiti cultural taste to the program.

As shown in (Tab. 1), the average score for participants' response was 3.8 when they were asked whether the frames in the British version were appealing. On the other hand, their average score for the Kuwaiti version was 3.4. (Tab. 4) reveals that the majority of Kuwaiti students and Kuwaiti experts preferred the Kuwaiti version in terms of the use of frames and borders, while the majority of British students and British experts preferred frames and borders in the British version. This part of investigation shows that Kuwaitis liked the use of Islamic colourful frames in the program, because their eyes are used to, however, they suggested to improve frames' quality, and to make better selections.

6.4 GRAPHICS AND IMAGES

Graphics and Images were scanned and imported in the two versions. They were used in the British version to reflect the British culture *(Such as British people or places),* while some graphics and images were used in the Kuwaiti version to reflect the Kuwaiti culture. (Tab. 5) reveals that the majority of Kuwaiti students and Kuwaiti experts preferred graphics and images in the Kuwaiti version, while most of British students and experts preferred graphics and images in the British version.

6.5 MUSIC AND SPEECH

Kuwaiti music were incorporated with the Kuwaiti version and British music were incorporated with the British version. As illustrated in (Tab. 1), the average score for evaluators' opinions about the appropriateness of the use of music in the British version and Kuwaiti version were 3.5 and 3.7 respectively *(Scale: 5 = very, 1 = not at all).* (Tab. 6) reveals that most of Kuwaiti students and experts preferred music in the Kuwaiti version, while British students and experts liked music in the two versions equally. Some British evaluators suggested the selection of better music, while others suggested to improve the quality of the music for the British version.

In addition, speech was performed by a Kuwaiti person *(speaking English)* for the Kuwaiti version, and a native British person for the British version. As illustrated in (Tab. 1), the average score for evaluators' opinions about the appropriateness of the speech used in the British and Kuwait versions were 4.2 and 4.0 respectively, *(Scale: 5 = very, 1 = not at all).* (Tab. 7) reveals that all of the Kuwaiti students preferred the Kuwaiti speech while Kuwaiti experts preferred speech in both versions *(could be because most of Kuwaiti experts have studied English abroad and lived with native English speakers).* On the other hand, most of British students and experts preferred speech in the British version.

7.0 RECOMMENDATIONS FOR NEW DESIGN

As the two versions of *Learn About PCs* are going to be redesigned based on the results of this study, we will summarise recommendations when redesigning the two versions. The objective is to increase the suitability of the two versions to users' culture:

1- Use standard icons for the two versions, however, remove the scanned images which were used as icons in the Kuwaiti version and replace them with drawn graphic icons which reflect objects in the Kuwaiti culture.
2- As participants have different perceptions about colours in general, and as colours seem to be a personal taste rather than cultural issue in this matter, background colours should be similar in the two versions. Light blue, light brown, or light grey background could be convenient for the two versions.
3- Improve the frames in the Kuwaiti version, choosing better and more culturally related, using only one or two types of frames throughout the program.
4- Improve the quality of graphics and images used in the two versions, add more graphics and images which are closely related to British and Kuwaiti cultures.
5- Change the type of music in the two versions, improve their quality, and make better selection.

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VCT: a new stage in ICT supported collaborative learning?

Herman van den Bosch
Faculty of Policy Sciences
University of Nijmegen
The Netherlands
h.vandenbosch@bw.kun.nl

Jeroen Bolluijt
Faculty of Policy Sciences
University of Nijmegen
The Netherlands
bluut@gironet.nl

Abstract: In 1998 a tool called the "Virtual Constructing Tool" (VCT) was developed within the Faculty of Policy Sciences. The VCT aims to facilitate the process of reading, discussing and producing papers with construction and communicating tools and is completely based on the use of the Internet. Each course in which the VCT is used is divided into two parts. In the first part, students construct their own knowledge system. In the second part, personal findings and opinions merge into a joint presentation. In this presentation, the leading part is played by the structuring of information with the help of hyperlinking. This paper shows the fundaments of the VCT and describes its main features. More information can be found on http://www.kun.nl/vct.

Introduction

The Faculty of Policy Sciences attaches significance to teaching in small groups with much student involvement and interaction between students and teachers. Students frequently work on co-operatively assignments, which result in a joint paper. The advantages of group work (see for instance, Eurelings and Rontelkap (98)) are strengthened by the use of hypermedia. Because of the increased user-friendliness of the Internet, a window has been opened to the development of a learning tool, which is completely based on the Internet standard. This tool is called 'Virtual Constructing Tool' (VCT). The VCT aims to enrich learning processes within groups and finally, it is "just as any co-operative learning method, a unique solution to the problem of how to structure a classroom" (Kagan 85).

Communication and action

Years ago, Bateson (51) distinguished the 'report aspect' and the 'command aspect' within communication. In the 'report aspect' communication is reduced to the transmission of information between people. For instance, a teacher recites new theoretical insights with respect to a subject. There is no need for action as a response to the information. The receiver of the information only has to remember the information and to be able to recall it on demand.

The transmission of information from one person to another also can be interpreted as a regulative act. The teacher's announcement that theory 'X' is most common, might result the studentswriting this down in their notes. It is the 'command aspect' that is responsible for this change in students' behaviour. Changes in behaviour can influence the different actor's interests. If information threatens the interests of the receivers, they will not only reconstruct the message but also question its content. They might reject its behavioural consequences and opt for a discussion with the sender of the message.

Critical social theory (CST) recognizes this possibility. This theory views people as intelligent actors who assess the truthfulness, completeness, sincerity and contextuality of the message they receive. A listener or reader can go beyond achieving a mutual understanding with the speaker or writer. This is accomplished by critical reflection, which assesses validity claims which pertain to what the speaker or writer means. The listener questions these validity claims and sees that it is incomplete, false, unclear or inappropriate. What CST offers is the recognition that communication among everyday actors also involves their need to assess the validity or justification of what is being communicated in the first place Ngwenyama and Lee (97).

Two stages

The CST has many applications. In this paper CST is a point of departure in the exploration of the contribution of hypertext in collaborative learning in general, and in the production of group papers in particular. Two stages can be distinguished in the accomplishment of a paper: reading and writing.

The reading stage

In the initial stage of the production of a paper, the reading of articles and books is a common phenomenon. The preliminary problem-formulation acts as guide. Reading is a process in which relevant facts and different views are listed. Gradually different insights are related and a view of the authors themselves arises. In the reading stage hypertext is used to collect and present information. In particulary, hypertext is a useful tool in relating different texts. Many authors claim that hypertext is superior to conventional texts in representing the interconnectivity of concepts (Berk and Devlin 91, Jacobson 93, Mayes 90) and therefore, the production of knowledge. Knowledge is taken to be a semantic network of related concepts. During the reading stage a personal classification of pieces of information grows. Research into the effect of the reading of hypertext documents on the integration of knowledge is an ongoing process (Jonassen 89, Siemon 95, Eklund 95).

An additional advantage of the use of hypertext is that articles quoted can be made accessible as a whole. By making hypertext links to summaries of relevant parts of their sources, students increase the clarity and solidity of their argument.

Some authors stress the role of hypertext in the process of the construction of meaning. Hypertext forces the reader - more than in the case of conventional reading - to actively relate different pieces of information (Landow 92, Jonassen 89). The resulting individual web of knowledge serves as a point of departure for communication with other students. However, effective communication requires a logical structure of information. The individual web has a logical structure for the individual student but not for the other group members. Structuring information in a logical order for members and other readers is one of the main targets of the writing stage.

The writing stage

If a certain threshold in the reading stage has been surpassed, then the writing stage will commence. Authors usually aim at convincing their audience and therefore papers take the form of an argument. The delivery of this argument requires restricting the readers' freedom to jump from one part of the argument to another. Instead, the author should present a degree of structure and sequence. The necessity of putting structure in a paper constrains the otherwise desirable network structure of information. A network structure offers only limited possibilities of determining what the sequence of an argument is. As a consequence, in the writing stage a structure based on hierarchical branches is preferred. Hypertext is deployed to facilitate this kind of structuring. Structuring based on hierarchical branches has several advantages:

The paper may contain many details and side-steps without damaging the main line of argument.

Students are forced to distinguish between bits of information according to their rank of importance in view of the argument.

The copying of pieces of text form others, schemes and definitions can be omitted. Hyperlinking to the original sources (of excerpts) suffices. More time and space are left for the student's own line of thinking and supporting facts and arguments.

Hierarchical branching offers lengthy possibilities for validation by the readers who feel its necessity. Those who prefer the reader's argument for its own sake will skim over additional elaboration.

The CST proposes that while reading a text, conveying of the meaning may include more than just understanding the writer's argument. The reader is entitled to critical reflection / validation (Kunneman 83). According to Habermas, each type of social interaction brings about a set of validation claims of its own. Ngwenyama and Lee (97) differentiate between instrumental, communicative, discursive and strategic action. Writing a paper is considered to be a communicative action. The main objective of writing a paper is discussion which possibly results in agreement. The possibility of validating the writer's claims is important while reading an argument. Hypertext is a tool 'par excellence' in the case of two kinds of validation claims: completeness and truthfulness.

Completeness: In writing papers with hypertext, it is no longer 'What is the content?' which is the main question but 'Where should I put this piece of information?'. Recording several types and quantities of information is allowed. The number of pages is not a significant restriction to the content of a paper anymore. Redundancy in the inclusion of facts and visions is also allowed. Each paper contains virtual archives which can be used for validation purposes or just for curiosity"s sake.

Truthfulness: Hypertext allows references to an abundance of articles, statistics and books. By enabling the reader to consult original sources, the verification of the validity of their application is within reach.

This option is not meant in the first place to discover deceit. However, it is commonly known that authors unconsciously interpret their sources in a way which is more advantegeus to themselves. In addition, more insight is offered in thc contextuality of the sources. Rasker et al. (98) talk about 'activity-based transmission of information'. Anderson's ACT-R theory explains the power of hypertext. This theory poses that the delay between the content of someone's reading and the reception of feedback influences learning. The bigger the delay, the less learned (Anderson 93). Hypertext allows for immediate feedback in a number of cases. For instance, incredible views can be checked immediately if supporting hyperlinks are provided. In the case of written texts, the threshold for consulting sources is usually unpermeable and only a few readers will engage in the painstaking search for sources in libraries. The addition of original sources increases their accessibility.

Reading the authors' sources adds to the understanding of the writer's line of thinking and contributes to the development of meaning and the reader's own personal interpretation. Reconstructing the writer's argument, he of she turns to the construction of his of her own insights (Schank 94).

In the case a of disagreement between the readers and the author of a paper, the readers should ideally also become writers too, and express their lines of thinking, by using hyperlinking as well. The original writer can respond and so forth.

Hypertext and the structuring of information

According to Beeman (Mayes et al 90), hypertext learning systems can fundamentally change students' learning. While building a hypertext system, students organize information in a non-linear way. Structuring information in a non-linear way stimulates the processes of integration and contextualisation. By making hyperlinks, existing knowledge and new information are consciously integrated. Students are constantly stimulated to construct new knowledge structures. Interchanges between the old and the new structures signify an increase in learning.

Pointing out the advantages of hypertext does not necessarily mean taking a position in the debate between the devotees of linear versus non-linear representation of knowledge (Ess 96). In fact, it is the degree of linearity or structure that counts. Jonassen divides hypertext into twe catogaries, structured and unstructured hypertext. In unstructured hypertext linking has no rules (Jonassen 89).

A fundamental belief behind unstructured hypertext is the desirability of relating information by means of association (Berk & Devlin 91). However, readers will comprehend the coherence within the information only if they share each other's associations. Because of a personal bias in regard to associations, this will not often happen. Maybe this is the reason why many users feel lost in a hypertext network (Mayes et. al 90)

Unstructured hyperlinking is allowed only for private purposes. Our students are urged to build a knowledge web of their own. Hypertext is used here in order to collect information and to relate pieces of information together. In the realisation of a group paper, unstructured hyperlinking is not tolerated for reasons of communicating effectively and the necessity of logical arguing, which implies imposing some direction and sequence.

According to Landow (92), linearity is not only typical in the traditional presentation of papers but it can also be found in the building blocks of a network structure. A network structure offers the possibility for readers to choose a sequence themselves. The more the author's goal is to convince readers of his or her argument, the more structure and guidance is implied. Within a predetermined structure, hyperlinking is a usable means for indicating alternative paths and viewpoints.

A predominantly linear structure is preferable in case of an argument, in a situation in which convincing another person is of essence. A non-linear structure offers more possibilities if an inventory has been made of knowledge structures or belief systems.

The role of the teacher

The value attaches to hypertext is based on the acceptance of constructivist principles in regard to teaching and learning: In a constructivist view, teaching is the facilitation of the rediscovery of knowledge and the conveying of meaning to various parts of the world. It is not the delivery of information. Students acquire knowledge if they become involved in an active construction process. They have to read texts, to compare various views of diferent authors and to be able to formulate their own views. The writing of an argument is a useful tool in reaching these objectives. The teacher can support students' construction activities by formulating an argument first and then inviting students to respond critically if it is necessary that they assume a perspective view themselves. To reach this goal hypertext is used, for instance, to admit students to the sources of the teacher's argument (Schank 94). Divergences from the teacher's thinking patterns, by reinterpreting his or her resources, deepens understanding.
A construction process, such as the one indicated above requires a permissive and discovery minded atmosphere in the classroom. The Virtual Constructing Tool (VCT) which is illuminated below offers ICT support in the students' collaborative reading and writing activities.

The composition of the VCT

The Virtual Constructing Tool has three different levels: the general level, the group level and the personal level.
General level: The general level is accessible to all visitors of the Internet. Everyone who deliberately or incidentally passesby can become acquainted with the course. E-mails can be despatched to the teacher and to the students. Students in their turn, will find schedules, learning materials, news items and answers to FAQ.
Group level: Students can log in to the group level by using a password. Only members of the group are admitted. The tools for writing a group paper are accessible from this level.
Personal level: The personal level is reserved for personal items, for instance, references, summaries, relevant links, messages to news groups and notes. As these items are all accessible from the Internet, students always have them at their disposal, regardless of the PC they use.
On this level, students make their own knowledge web, which consists of Internet pages dealing with their specific themes. These pages are the building blocks of the group paper.

Students are invited to design personal pages. It is a useful exercise, which contributes to the social atmosphere of the group. "Whether or not software tools designed to support collaborative learning will actually do so, depends mainly on to which extent the instructor and the students are able to create a social structure which supports these processes." (Keynes 97). Photographs of the group members also contribute to this goal.

The devices of the VCT

The devices of the VCT are divided into Construction tools, Communication tools and Help. All devices enable time and place independence. Obviously, students may have meetings or use more conventional tools such as a telephone or a faxmachine.

Construction Tools

The construction tools support students in designing Internet pages. Students have at their disposal style sheets and the so-called 'html bank'. Style sheets are ready-made Internet pages, in which students only need to type their own texts. A professional lay out and background is provided.
The html bank offers pictures, buttons, symbols and other graphic tools, so that students can use these to prepare their papers.

Communication tools

In addition to all the usual communication facilities, the students have course conferencing and the so-called 'mutation form' at their disposal. Course conferencing enables students to communicate with all the course members. They can type in a message or respond to messages they have received. All messages are presented in sequential order. It is possible to include links to the group level or to external Internet sites.
Students use the mutation form in order to propose mutations in other students' papers. Mutations may concern parts of the text of the inclusion or exclusion of links. The proposed mutations usually lead to discussion.

Help
Students' computer abilities differ considerably. The Help function offers a manual, answers to FAQ and a guide for seeking on the Internet. Of course, contacting the Webmaster is also possible.

Conclusion

The VCT is used during four different courses. In all of these courses, additional changes have been made in the use and appearance of the VCT. We should gain more experience before sustaining the possible advantages for using hypertext in writing papers. For the time being, these temporary findings can be given:
Students and teachers are used to strictly linear thinking. In using the VCT, they must abandon this way of thinking and become used to connecting pieces of information through hyperlinking. It takes time before they become accustomed to structuring information in this way. Afterwards, the assignment appeared to not be suitable enough for structuring information by means of hyperlinking. However, writing a paper in this way was not experienced as being more difficult than was usually the case.

In addition to all usual communication facilities, students can use the facilities within the VCT. However, in true practice, no one used these facilities. The reasons were mentioned, which were lack of speed and interaction. Insufficient computer equipment at home (whether they had an Internet connection or not) was also seen as a limitation.

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Getting Computer Information Technologies Used in Teaching and Learning: A Model of Technology Diffusion in a K-10 School.

Lyn Henderson
School of Education, James Cook University,
Townsville. Australia. 4811
E-mail: lynette.henderson@jcu.edu.au
Ph: (61) (7) 47 814 355; Fax (61) (7) 47 251 690

Scott Bradey
Technology Coordinator, Charters Towers School of Distance Education
Queensland. Australia.
E-mail: sbradey@chartowesde.qld.edu.au
Ph: (61) (7) 47 875 733; Fax: (61) (7) 47 875 784

Abstract: Technological diffusion in schools is a complex process that has not met expectations. The paper identifies a model adopted by a K-10 school of distance education: the *Multi-Dimensional Emersion Model of Technology Diffusion*. It analyzes the process, including technical, pedagogical, and coercion and commitment issues. Evaluation of the outcomes of the whole school approach of the first year of adoption revealed general approval of the process, some disquiet concerning overt recognition by administration, and a majority who were able to move outside their comfort zone.

During the last decade we have witnessed a significant rise in the number of computers in schools. However, the integration of educational technology in school curricula still lags behind earlier expectations. Reports and researchers have tried to explain this gap, usually in terms of a failure by colleges of education to expose students to educational technology and to train them adequately in this area, budget limitations, the teachers' fear, reluctance, and often resentment to incorporate computer technology in their classrooms, and infrastructure organizational difficulties. Effective technological innovation is such a complex process and so difficult to accomplish within school cultures that the literature identifies "islands of excellence" (Willis, 1996). This paper reports the first year phase in a Pre to Grade 10 school of distance education's journey to create such an island. The specific aims are to identify the model of technological diffusion adopted, analyse the processes, procedures, and conceptual frameworks that were utilized, and evaluate the outcomes.

Methodology

A qualitative research methodology was employed. The study utilized the initial workshop evaluation, a needs assessment survey, a post 53 five point Likert Scale questionnaire, open-ended structured questionnaire, teacher project documentation, observational data from the teachers' presentations of their WWW project to their peers, and anecdotal evidence from the technology coordinator. The documentation contained teacher evaluations of computer software and WWW sites as well as unit plans detailing the incorporation of their selected piece of software and WWW site into their curriculum.

The Charters Towers School of Distance Education (http://www.chartowesde.qld.edu.au/) previously, School of the Air, is situated in North Queensland, Australia. It provides education to preschool to Grade 10 children, anywhere in Australia, who live at a distance to the nearest state school, are in hospitals, belong to travelling families, or are taught at home. The School's Development Council decides the strategic direction policies of the school but not its operations; it comprises equal representation from parents or caregivers and school staff. The school uses traditional means of communication like mail and telephone as well as radio for daily half-hour synchronous lessons between the teacher and students, video, television, and, since the beginning of 1998, the Internet to cross the barriers of distance and create the bonds of a school community. Where possible, face-to-face contact with students is achieved through structured student-family camps at the School when formal lessons are conducted and informal learning and socialising occurs between family and school, and by teachers through excursions, home visiting, and outreach activities.

All 37 teachers (Preschool through to Grade 10; one teacher-librarian, and two Languages Other Than English) were involved in the technology project. There were five male teachers and 32 female teachers ranging in age from 22 years to 50 years. Some had been in the school for up to eight years and were therefore experienced in distance education, while six teachers were appointed from regular urban public schools to the distance education school in 1998. Most had not extended their knowledge beyond the wordprocessing applications and the majority had had little experience with E-mail and even less with the WWW prior to 1998.

Results and Discussion

Our model of technological change, the *Multi-Dimensional Emersion Model of Technology Diffusion*, was identified from the data. Nevertheless, it is not surprising that it echoes theoretical models of school change or includes elements that other projects have identified as fundamental for successful diffusion. Understandably, it also contains innovative facets that incorporated aspects and shapes of existing practices and values particular to the Charters Towers School of Distance Education. The paper proceeds to discuss the model highlighting elements of similarity to, and difference from, other paradigms of technological diffusion and school change. The model is a combination of what we term, "markers-of-significance", that were put in place at the beginning of the technology diffusion project or evolved as it proceeded.

One of the markers identified in the model is the ***decision-makers.*** As the decision to focus on technology diffusion was made by the School Development Council, which involved teachers, it was not perceived as a "top-down" imposition by any of the teachers (Post Likert Questionnaire). The Council made certain global decisions or big picture decisions to do with school change. These global why, what, when, and how decisions involved a funnelling effect to the other stakeholders.

The "why" decisions involved the rationale and aims for the school to be at the forefront of computer information technologies so that the students would be well-served for the present and future. Effective school aims need to become the "common ground, the shared vision that compels all involved" (Meacutendez-Morse, 1992). All but four teachers supported the technology infusion in their professional lives and their teaching: "I embraced it as it is the way of the future for me and the students"; " I found it exciting as I could see its potential in student learning"; I enjoy the challenge of learning about technology" (Open-ended Questionnaire). In this respect the multi-dimensional emersion model reflects the re-educative/culture/fix-the-system attributes of Hord's (1992) generational model.

The "what" decision embodied aspects of the "fix-the-parts" and "fix-the-system" change model (Hord, 1992). It involved resourcing the vision or putting dollars where they would make a real difference. The school funded equipment, such as a laptop computer with a standard suite of software for each teacher, an Internet infrastructure and online costs, and a computer laboratory for in-school camps. Students' families were provided the opportunity to either purchase or lease a computer and printer from the school, including the standard package of software. The resourcing decision also resulted in the appointment of a teacher as a half-time information technology (IT) coordinator-half-time teacher. It was a significant resolution and commitment to change. This decision, which teacher representatives were party to, highlights the teachers' corporate commitment to the school's vision; their 100% agreement (Post Likert Questionnaire) meant they had to cover the IT coordinator's half-time teaching load when he wore his IT coordinator's hat training and mentoring the school community: staff, students, and home tutors. The multi-dimensional emersion model therefore did not lack appropriate resources which Boyd (1992, p. 25) argues has been "a major barrier to sustained change efforts".

The "when" decision resulted in a two-year time-line for information technology diffusion to be the school's major economic and pedagogic focus. This "fix-the-system" approach eschewed a global linear approach where step two did not start till step one was completed (Carr & Duchastel, 1998). For example, the school did not wait till all the staff had a laptop (the last few teachers received their laptop towards the end of the research) before commencing induction programs or appointing the IT coordinator. Twenty-one percent of the teachers (Post Likert Questionnaire) voiced a "too much, too soon" concern in their questionnaires. They would have preferred a linear approach so that they would only have had to cope with frustrations on one level, their own computer skill progress, rather than on a number of levels, including coming to grips with the pedagogic changes needed for incorporating the WWW into their teaching and technical failures (Open-ended Questionnaire). According to Geoghegan (1994), such a preference for incremental change as opposed to discontinuous and often disruptive breakthrough alterations in core processes is not uncommon.

The "how", fix-the-people - fix-the system (Hord 1992), decision resulted in an emersion model which involved all the teachers rather than a slower approach to training volunteers who would enthuse other staff to adopt the necessary pedagogic changes to their teaching. Louis and Miles (1990) preferred such a slower evolutionary method and cautioned that it's non-adoption could mean death to innovation. The teachers perceived the opposite with only 7% disagreeing with the items: "A small number of enthusiastic or knowledgable teachers should have been involved first" and "The Grade 6-10 teachers [the only grades whose students were provided with a home computer] should have been inserviced first" (Post Likert Questionnaire).

The major input into the nature of these global decisions came from the school principal, who also had the job of operationalizing them. One aspect of this was communicating the administration's and the School Development Committee's expectation that the staff would become meaningfully involved in the diffusion of technology. That expectation was accompanied by a high level of trust that this would naturally happen because trust meant recognition and acknowledgment of the teachers' professionalism. These sorts of elements appear to echo the empirical-rational and power-coercive strand of Hord's (1992) generational model. Operationalized, this meant the principal adopted a direct hands-off approach. The data reveals that the principal was definitely perceived by the teachers as a necessary catalyst for change. However, 21% of the teachers (Post Likert Questionnaire) would have appreciated an increased level of direct involvement, particularly in terms of individualized praise and understanding of what they were accomplishing.

The second marker of significance in our model of change was the ***IT coordinator.*** Casey's (1992) distributed expertise model emphasized the importance of leadership in school change, not just from the principal but also from others, such as an IT coordinator. This role was a two-way conduit-facilitator between the principal and the teachers. This duality was probably a significant factor in how the IT coordinator exercised his expertise. The teachers reported that he helped them develop images of "how to get there" that were tied to a workable reality. This is one of the factors that Boyd (1992) argues helps teachers develop a sense of ownership of the diffusion process. This perception suggests that all three generations in the "normative-re-education - culture - fix-the-system" model (Hord 1992)were in operation.

The how and what of inservicing staff was left to the IT coordinator. A multi-faceted model of professional development was adopted. According to Topp, Mortenson, & Grandgenett (1996), this is an important factor in school change because no one method of staff development works for all teachers. The Consortium for Policy Research in Education (1995) maintained that the most promising professional development programs are those that stimulate and support site-based initiatives because they are not isolated from classroom realities. The multi-dimensional emersion model certainly contained this ingredient. It was based on a needs analysis the IT coordinator conducted with the staff to ascertain their requirements and concerns. Inservicing involved traditional workshops, provision for peer collaborations, mentoring, and residential workshops.

The professional development program followed a linear time-line unlike the overall project which overlapped the phasing in of key elements. The reasons were specific to the school's context. The program capitalized on the division of the Australian school year into four terms of approximately ten weeks each. Each term had a distinct focus. The first phase of the inservicing was a series of non-compulsory workshops dealing with wordprocessing, spreadsheet, database, desktop publishing, E-mail, and WWW access and search skills. These were held weekly for most of the first term. According to the data, 93% agreed that this was a sensible approach (Post Likert Questionnaire); it allowed the IT coordinator and other new teachers to settle into teaching at a distance and all teachers to obtain a comparable level of technology skills. It also afforded staff a welcome distance from the networking hassles. In effect, it gave the teachers valuable time to begin to internalize what the school vision would mean in its actualization. Compulsory workshops were conducted in second term and third term to explore the pedagogy involved in evaluating and using educational multimedia software and the WWW, respectively, as teaching and learning tools. Each of these sessions involved three compulsory after-school workshops that addressed theoretical and hands-on practical issues. Teachers were not overly-disgruntled about having to spend their own time after a long day, being re-educated (Post Likert and Open Ended Questionnaires and Anecdotal Records).

The teachers consistently reported a very high rating on items ascertaining the facilitative effectiveness, level, and type of support of the IT coordinator with only seven percent undecided about the appropriateness of the level of support (Post Likert Questionnaire). During the whole process, the IT coordinator provided "just-in-time" mentoring and support for individuals and groups as either he or the teachers saw the need (Open-ended Questionnaire). Many teachers reported that they perceived the IT coordinator's praise and enthusiasm for their achievements as motivating and rewarding with a few explaining their belief that this attitude was not tokenistic as it was blended with useful critique (Open-ended Questionnaire). Sashkin and Egermeier (1992) concluded that the "more personal assistance and continuing support from a skilled and knowledgable local agent, the more likely that the innovation will be used for a long duration" (p. 7). Hopefully, long-term evaluation will prove this correct.

The third marker-of-significance in the model is the ***teachers***. For a variety of reasons, teachers are not particularly malleable to change (see Hord, 1992). Thc school principal made it clear to staff that the school's two year focus on the integration of technology this would involve commitment to the inservice that the IT coordinator devised. This certainly contains elements of the power-coercion - political - fix the people change model (Hord 1992) yet it also involves the re-educative - fix the system model (Hord 1992) because a majority of the teachers had taken on board their personal commitment to their re-education (Post Likert and Open-ended Questionnaires). The innovation involved exemption from non-project commitments, such as a residential workshop based off-campus at the district university, and after school hours workshops. Interestingly, few teachers commented negatively on these compulsory after-hour workshops (Likert Questionnaire). Many reported that the time was more than compensated by the chance "for working together and learning together" (Open-ended Questionnaire). It is not only technical resources that count but also the time and energy demanded of people to plan, share, observe, and take action. (Boyd, 1992).

Teachers were offered the opportunity to work individually, in pairs, or in a small groups on their curriculum units. Only four teachers and the teacher-librarian worked individually. Most opted to work in pairs for the interactive multimedia CD-ROM activity with most working as groups of three on the WWW activity. There appear to be four major reasons for their collaboration: (a) it permitted the pre-school and primary teachers to brainstorm ideas for their common grade levels while the secondary teachers collaborated in discipline areas; (b) time constraints meant collaboration allowed a reduction in individual time spent resource hunting and unit preparation; (c) it provided security through peer support; and (d), it divided the responsibility for designing units that incorporated the software and WWW site in meaningful contextualized ways. The data reflects what Boyd (1992) reported: skill building and training are part of the process of change and, hence, learning to do something new involves initial doubts about one's ability and incremental skill development.

Outcomes are obviously another marker of significance. The teachers' self-reported outcomes included: increased confidence; improved competency in computer skills and Internet usage, particularly search strategies; recognition of self and others efforts; ability to integrate CD-ROMs and the WWW as learning tools in their curriculum; using CD-ROMs and the WWW with students and witnessing their growth and enjoyment. A number still acknowledged their need for continued improvement due, in part, to not utilizing the skills or implementing the strategies regularly. There appeared to be little technofatigue. Three months after the first year, all but three teachers (one was indifferent) reported that they still found learning about technology and its incorporation into curriculum enjoyable and were "not getting tired of it": "No way!"; "To live is to learn"; "I 'm still learning and enjoy the challenges" (Open-ended Questionnaire).

Examination of the documentation data, their unit plans and the teachers' presentations of the WWW units, revealed that most teachers treated the professional development tasks seriously and professionally. The others handed in tokenistic work. A majority of teachers appeared to change their pedagogy to integrate new ways of teaching and learning into their curriculum. They had grappled with the necessary pedagogical changes to their thinking and practice. The Open-ended Questionnaire reported an acknowledgment of their successes and, for many, a current determination not to "backslide", as one respondent worded it. The outcomes of the minority group of teachers can be depicted as a brief sojourn out to the world of the Internet and interactive multimedia CD-ROMs. Overall, for the majority, the data revealed that their world was not the comfortable status quo oyster where a minority of the teachers still positioned themselves.

CONCLUSION

Any change paradigm, like the multi-dimensional emersion model of technology diffusion, will always incorporate elements of coercion, pressure, and support. It is getting the weightings and timing of them about right that is often crucial. The key to any change strategy is the word "persistence". Resource provision, professional development, teacher commitment, ongoing assistance, and recognition can not be one shot events or quick fixes (Hord 92; Beer, Eisenstat, & Spector, 1990). Currently, at the end of phase one, it seems that the change effort was more than an illusion for a majority of teachers. Implementation of phase two needs to monitor the "persistence" factors if long-term success is to be the outcome.

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Towards the Virtual Class: Technology Issues from a Fractal Management Perspective

Philip Uys
Hydi Educational New Media Centre
Wellington, New Zealand
philip.uys@wnp.ac.nz

Abstract: This paper addresses the research question: *What are some of the key information and communication technology issues from a fractal management perspective when implementing the virtual class in conventional higher education?* It also suggests effective management strategies for dealing with the identified issues. The specific manifestation of the virtual class referred to in this study is when the virtual class is based on Internet and Intranet technologies. The term "networked education", coined by the writer is used to describe this expression of the virtual class. The study concludes that the implementation of the virtual class in conventional higher education has an extensive and profound impact on, and demands new ways of using and managing information and communication technologies.

1. Introduction

"The single most frequent failure in the history of forecasting has been grossly underestimating the impact of technologies"
Anon

The research question addressed in this paper is: *What are some of the key information and communication technology issues from a fractal management perspective when implementing the virtual class in conventional higher education?* This paper attempts to identify what some of the key technology issues are when the virtual class is implemented in conventional higher education and ways to address these.

Tiffin and Rajasingham (1995) argue that communications have a fractal dimension that is "a node in a communications network can prove, on closer examination, to be a communications network itself (p. 37). The technological issues are also viewed from a fractal management level that is to acknowledge the various levels and dimensions of management the management processes of the institute, administration, the departments (both academic and administrative), the design, development and delivery of teaching materials, the student's learning and so forth. "Management" in tertiary education does not refer to "administration" only. To limit management to administrative practices only and thus excluding the teaching area would be to argue that planning and decision making, organising, leading and control do not occur in the area of teaching, but only in administration. "Management" refers therefore to management on all levels of the organisation, both in the teaching and administrative.

2. Creating Visibility in A Virtual World

Rayport and Sviokla (1995) summarise the essence of the virtuality of the virtual class when they write about a corresponding phenomenon in the business world that they term the "marketspace" that is a virtual market place. They characterise it as being "virtual" because the value-adding processes "...are performed through and with information".

Tiffin & Rajasingham (1995) first used the term "virtual class" to refer to the learning process that is enabled solely by telecommunications. Tiffin & Rajasingham (1995) distinguishes the concept of the virtual class from the "Virtual Classroom" coined by Roxanne Hiltz (1986) as "...it suggests that the place a virtual class is held is an electronic simulation of a conventional classroom" (p. 10) because Hiltz described it as the use of computer-mediated communications "...to create electronic analogue of the communications forms that usually occur in a classroom including discussion as well as lectures and tests" (p. 95).

The virtual class can be described as the process that occurs when teacher, learner, problem and knowledge are joined solely through communication and information technologies for the purpose of learning and teaching. It is an educational experience of real people in a virtual dimension. In the virtual class the teaching and learning is performed without the movement of physical objects (eg getting students and lecturers into a physical venue).

The specific manifestation of the virtual class referred to in this study is when the virtual class is based on the Internet or Intranet technologies. The term "networked education", coined by the writer is used to describe this expression of the virtual class. Networked education emphasises the high level of connectivity that it enables through creating a network between student en student, student and teacher, student and resources, teacher and resources as well as the past and the present (through availability of on-line resources of one course occurrence for a next occurrence). It also indicates that the education is network-based (Internet or intranet) and computer-mediated, that it includes teaching, learning and research ("education"), and emphasises the distribution both of the control of learning, as well as the on-line learning and teaching materials among the students and teacher(s).

The virtual nature of this type of learning can remove the conventional prompts to assist the learner to focus on their studies for example when the lecturer starts to speak in a face-to-face on-campus lesson, or the arrival of study materials in paper-based distance education mode. It is therefore essential in the virtual environment to build in prompts to assist in this area for example automatic e-mail based on the course schedule as well as on the participation of each individual student.

3. Providing Mobility in the Virtual Class

The most significant loss students often experienced in an on-line environment are the lack of mobility of the study materials.

The affordability and weight of portable computers such as Laptop computers and notebooks negate these technologies from being an adequate provider of mobility. Smaller hand-held palmtop computers with infrared updating capabilities are a positive step in re-creating the mobility for on-line students.

Another development which is currently experimented with by MIT (Nicholas Negroponte at the 1997 ICDE Conference) and by commercial companies in the US, is to address and program pixels on paper which has all the characteristics of wood-based paper except that it is made of specialised materials. Pages in such a book can be loaded with information form the Web or other electronic sources and copied and pasted into other applications. Each page has a huge capacity to store information and can be continuously updated and reloaded. This will be a major breakthrough to provide students of the virtual class with both mobility and a totally new level of flexibility.

4. The Pervasiveness of Communication and Information Technologies in the Virtual Class

A complete set of technologies, which have become transparent through their pervasive integration into every-day life is required to make conventional on-campus or distance education possible. This set of technologies include roads, vehicles, electricity, air conditioning, buildings, ducting, clothing, aids such as spectacles, food preparation technologies, piping, systems dealing with waste, entertainment systems and so forth. At the same time these technologies require skills and knowledge which in most cases have become totally transparent through our frequent and natural use of it for example navigating buildings and roads.

The virtual class is per definition based on communication and information technologies. Education in this environment similarly needs a whole range of technologies, which often corresponds to the ones described above. At this stage the technologies required to enable the virtual class are however not only in its infancy and undergoing revolutionary changes, but the full complement of what is required is not even fully clear yet. In the current phase of establishing the virtual class, there are often new realisations of totally new technologies needed or significant changes required to existing technologies (like Word-processing HTML documents). It might be that the virtual class at this stage is creating more questions than being nicely tied down according to our traditional conventions. In this scenario communication and information technologies can be seen to be more of a hurdle than an enabling agent.

The virtual class therefore requires of both student and lecturer to assume a sophisticated level of computer literacy and use. While the on-line lecturer may have support within the tertiary educational institute through a computer department and a network of colleagues, the students often may not have the same advantage. It is therefore essential to provide technical assistance not only via on-line help information, but also through a technical help desk function which can be reached by telephone and fax.

A conventional tertiary educational institute interested in using technology-based education like the virtual class seems to require therefore an extensive use of CIT throughout the organisation. At the University of Melbourne, Australia, where a campus wide information system (CWIS) was implemented, Goldenfarb (1995) noted that one barrier to the successful implementation of the CWIS was low IT skills. Goldenfarb also notes that "...if the problem is identified, it can be overcome and the department can become a successful adopter".

In embracing the virtual class, an organisation per definition also embraces communication and information technologies on a wide base and with it the requirement for higher and new levels of computer literacy of their academic an administrative staff as well as their students.

5. Managing Discontinuity in the Virtual Class

In networked education the materials and teaching process is in a state of continuity while these are in a state of discontinuity in conventional tertiary education. Once a course is on the Web, it remains available and no special arrangements need to keep it continually available; special arrangements however have to be made to discontinue availability.

Effectively managing the discontinuity of on-line materials as a result of the discontinuity of human involvement is vital to meet student expectations and provide ongoing support, and in so doing avoiding that the institute comes in disrepute. An example of discontinuity is when a course is in a specialised academic area and the lecturers discontinue their involvement with the course. The on-line course materials will still remain on-line and might become obsolete, or when removed causes frustration to on-line users when unsuccessfully attempting to locate it.

In a paper-based distance education environment or a face-to-face physical teaching environment, the discontinuity of a lecturer can be addressed by the discontinuity of the mailings or the classes at an appropriate point. Two factors contribute to the problem. Firstly the on-line materials are often registered with search engines and guides on the Internet. The URL is then bookmarked within a web browser by users who may also share the URL with others in a network of contacts. Secondly the on-line materials need to be kept up to date if it needs to remain available.

The virtual class thus needs special approaches to ensure a seamless discontinuity like de-registering the materials with the search engines and guides, replacing the course materials with clear notices to that effect or contacting those whom the institute know have bookmarked the materials.

6. Effective Data Management in the Virtual Class

It is quite staggering to see how many computer products for the development of on-line courses take the notion for granted that course elements ("course objects") - including media elements - are to be stored in flat directory structures.

Often the HTML files media elements and scripts are being stored on servers in an organised flat directory structure, which is reminiscent of how data was stored before the 1980's. Since then relational databases and object oriented databases have clearly emerged as more effective and sound ways of storing information in computer systems.

Some comprehensive and specialised databased software have been developed for on-line course generation eg "Hyperwave" (initially developed as "Hyper-G") (Hyperwave 1998) and TLM (The Learning Manager) and Lotus Learning Space.

7. Bridging Transactional Space in the Virtual Class

A major challenge in the virtual class is addressing the issues of dialogue across the response and psychological distance between teacher and learner. "Distance" in the virtual class however is no longer defined in terms of physical proximity but in response time (comment made by Nicholas Negroponte at the 18th World International Council for Distance Education Conference in June 1997).

There is also another type of distance which Caladine (1993) explains as 'transactional distance' which is the psychological distance between learner and learner, and learner and teacher. Caladine indicates that transactional distance in technology-delivered education is greatly impacted by the technology itself: "...one of the most important determining factors is the medium of communication". Terry Evans and Daryl Nation (1992) seem to agree when they state that virtual class practices "...do not eliminate the problems of distance between teachers and learners but create their own" (p. 9).

Complicating this issue is a changing relationship between student and lecturer. In the conventional class, the teacher often has a one-to-many relationship with the students, which is based on the conventional teaching model as well as on convenience for the students. Students in a course will often relate with the academic community solely via the convenor of the course when seeking clarification, feedback, additional instruction or wish to challenge ideas. The on-line student however is "...no longer confined to our campus and its teachers and students and activities" Tiffin (November 1996). The student now has various teachers accessible by e-mail and geographically located anywhere in the world. This was vividly illustrated when the writer wanted to clarify an aspect of Roger's (1983) diffusion of innovation theory and was able to use electronic mail to contact Everett Rogers personally and received clarification within 24 hours through a reply electronic mail (Rogers, E. Re: Top-down approach. everett rogers <erogers@unm.edu>, 10 July 1998). The student in the virtual class, through an extended group of on-line teachers, can therefore be more challenging and also more knowledgeable than the conventional student. Furthermore, lecturers might have to deal with a new relationship with their students which is not one-to-many but *one of many*.

Synchronous on-line communication facilities like Internet Relay Chat (IRC), voice, video-conferencing and shared whiteboard facilities over the Web provide social interaction in a more natural way, and also build some accountability into on-line courses. Asynchronous mechanisms like electronic mail, hypermail-threaded message and newsgroups are effective in bridging both time and space.

Addressing the social needs of on-line students and on-line teachers are critical. Strategies like newsgroups, electronic mail discussion lists, synchronous on-line meetings, arranging some kind of meetings in the physical realm with other students, designing courses with a high level of interactivity and using photographs and video clips of students and lecturers within a course can all be used to address these needs.

8. The Nature of Change Required When Implementing the Virtual Class

Taylor, Lopez and Quadrelli (1996) comments on the work of Morrison believe it to be improbable, as technology becomes more pervasive in all aspects:

> ... and suggests that our thinking about those issues itself must recognise that a 'smooth evolutionary transition' to the widespread use of more flexible modes of delivery is not likely. Indeed, his work suggests it may be far more productive to conceptualise the process of evolution in terms of dislocations, dilemmas and uncertainties rather than projections from 'what is' to 'what is needed'.

At the University of Melbourne, Australia, where a campus wide information system (CWIS) was implemented, (Goldenfarb 1995), a research project looked closely at the first ten departments adopting the use of CWIS and set out to test if critical success factors in diffusing innovations, identified in the literature and at other universities played key roles in diffusing the CWIS in this University. Goldenfarb found that:

> In the final analysis of departments against criteria measures for successful adoption, the departments that recognised the low skills as barrier found solutions to this problem and rated highly in the ranking order. On the other hand, the department that had very high IT skills but did not see a clear advantage in adopting ranked last. The department that did not see a clear relative advantage didn't have full commitment from the head of the department. Many other departments reported success in obtaining commitment from the leader, when clear benefits were demonstrated in trial/pilot projects.

Understanding the benefits of the virtual class, like possible productivity increases of academic staff, is therefore essential for administrative managers and academic staff to take a positive interest in the implementation of the virtual class.

9. Conclusion

The possibility in the virtual class to work collaboratively has become a strong motivation to consider networked education. This is not surprising if one considers the nature of the underlying distributed technologies of the virtual class that is the Internet and intranets - the purpose of which in essence is to enable connectivity - be it to share resources or contact other people. This fundamental characteristic of the virtual class needs to be fully explored in areas like on-line communication, use of on-line resources, collaborative research activities and the transnational recognition of prior learning and qualifications.

Does conventional tertiary education have the ability to change as dramatically as the new media seem to demand> Can it respond in such a flexible, dynamic and adaptable way? Thomas, Carswell, Price and Petre (1998) argues for the "transformation of practices (both teaching and administrative) to take advantage of technology in order to provide needed functions, rather than superficial translation of existing practices".

Taylor, Lopez and Quadrelli (1996) believe it to be improbable:

As technology becomes more pervasive in all aspects of teaching and administration, both academic and general staff roles are being transformed. New positions and skills are required across all key areas. From the diversity of staff development strategies and activities that universities are adopting, we identified three approaches to deal with this challenge. These approaches will need to support an accelerated shift from teaching to learning, delivered not by individual lecturers but by multi-functional teams. Universities are poorly equipped and under resourced to manage this strategic change.

It is important that the future must not be inhibited by what we have been doing in the past; we have a great opportunity to rethink teaching, learning and research; to uncritically replicate in the virtual class what happens in conventional on-campus and distance education would be a tragedy.

"In a time of drastic change it is the learners who survive;
the "learned" find themselves fully equipped
to live in a world that no longer exists"

Eric Hoffer

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SHORT PAPERS

Collaborations in Educational Multimedia: Realizing a Culturally-authentic, Contextualized Image Database for Spanish and French Instruction

Oscar Retterer, Director of Academic Technology Services, O_Retterer@fandm.edu
Kimberly Armstrong, Associate Professor of Spanish, K_Armstrong@fandm.edu
Franklin & Marshall, Lancaster, PA USA

A major benefit of incorporating multimedia and technology into foreign language learning is that it can provide students with something resembling, albeit loosely, an immersion experience. Linking the classroom to authentic sounds and images engages the student in the learning process; it makes language learning more than a series of verb conjugations, and instead a richer experience. If we can engage the student, then we have a better change of making him/her a successful language learner.

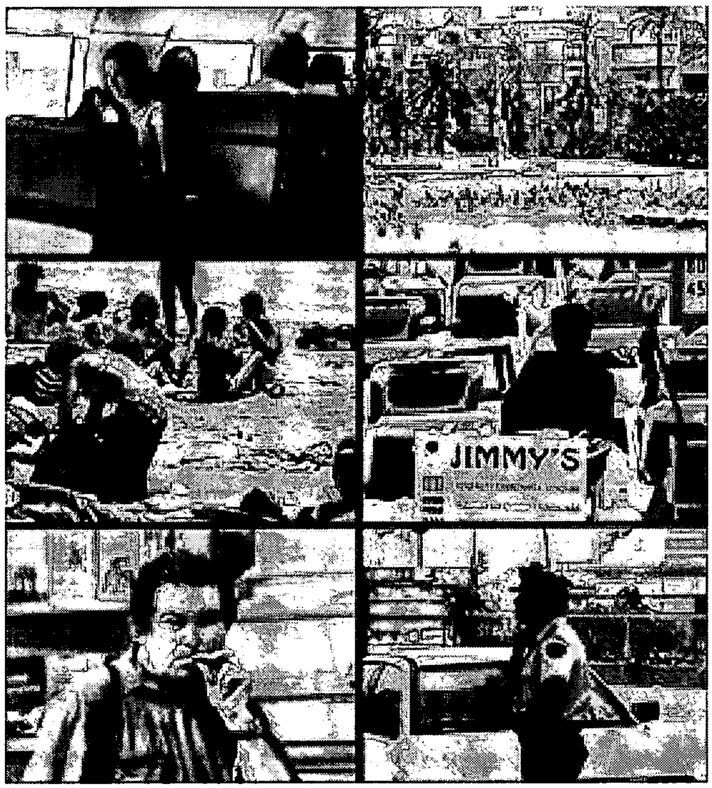
One of the goals of our language programs is to help students achieve advanced levels of oral proficiency in the foreign language while giving them as much exposure as possible to authentic cultural information. In order to enhance language learning possibilities, we decided to take advantage of advanced digital imaging technology to provide culturally rich virtual learning environments for our students. A special program at Franklin & Marshall, the Academic Technology Venture Fund for Curricular Innovation, allowed us to create an intra-departmental archive of culturally authentic French and Spanish digital images. We are using these images to create innovative activities which can be tailored to various levels of language learners.

The Academic Technology Venture Fund for Curricular Innovation was established to promote faculty initiatives that enhance opportunities for curricular innovation through instructional technology support that foster teaching and learning. Through a competitive application process, the Venture Fund awards several mini-grants of up to $5000 each to support curricular project design, development, and implementation. Collaborative projects exceeding $5000 are also possible. One of the advantages of the Venture Fund is the collaborative nature of the projects. Content experts can rely on technology experts to help create the applications needed in order to deliver the class materials in systematic, efficient, and professional package to students.

The first priority of this project was to establish an archive of culturally rich images; we sent a student who was fluent in French and highly proficient in Spanish armed with both a digital camera and a standard 35mm to Spain and France in order to record these images. We provided him with a "shot list" that included items from monuments to bidets to couples holding hands. We expected the student to return with about 1000 pictures -- he returned with nearly 2000, including those of Paris after the 1998 World Cup! Approximately 1200 of these images were recorded digitally while the remaining 750+ were taken with print film and then transferred to Photo CD™.

Upon the student's return, our second priority was to create a database and categories for that database in which to insert information about each image. This included information about where the picture was taken, the elements within the photo, and a series of keywords. This aspect of the project will result in a searchable web site that instructors can use to create classroom applications and that students can use to research both oral and written projects.

While the images have already been used for multiple purposes, one specific project that we have developed promotes oral proficiency. As we began to view the images, it became clear that they could be used to create narratives, a key feature of advanced level speakers. One of the most difficult leaps that a language learner makes is the progression from being an intermediate level speaker with the ability to describe the here and now to an advanced level speaker who is able to talk about events which occurred in the past. Textbooks at every level spend time talking about how to talk in the past, but students are rarely given enough time to really work on this aspect of acquisition before they are moved on to another grammar point. The "storyboards" that we create for students give them the opportunity to further practice this skill using authentically appropriate images that are linked to the vocabulary that they have been studying. These storyboards can be a brief as four images or as long as eight. For intermediate level speakers, there is a logical sequencing to the pictures and a common theme. For instance, one storyboard (below) contains six images: a young woman on a plane, a picture of a beach in Spain, a close-up of sunbathers, a young man renting out lounge chairs on the beach, a shady character smoking a cigarette, and a police officer. Students have the opportunity to create a story using these images so that their language creation also occurs within a context. Students also record their stories orally without the opportunity to write anything down since our goal is to improve oral proficiency with this project. We expect that students will complete five to six of these stories throughout the semester with the instructor providing feedback for each story. Students access the storyboards via our campus network, and eventually they will be able to do so via a website.



This classroom application is something that we would not have been able to do within a traditional classroom. We would need to either spend classroom time passing the pictures to each student or create 20 different storyboards so that students could take them home and work with them. Given the fact that we intend to have students complete five of these narrations, that would involve over 100 storyboards and at least 400 pictures. Technology has given us a tool to deliver this application to students in an efficient manner and has already provided us with essential information about how non-native speakers tell stories in a foreign language.

The Effect of Hypermedia Delivered Modeling On Learners' Self-Directed Study during Problem-Based Learning

Susan Pedersen, University of Texas at Austin, Department of Curriculum & Instruction
sped@mail.utexas.edu

Douglas C. Williams, University of Southern Louisiana, Department of Curriculum & Instruction
dwilliams@usl.edu

Min Liu, University of Texas at Austin, Department of Curriculum & Instruction
mliu@mail.utexas.edu

1. Research Framework

Problem-based learning (PBL) is an instructional approach that uses problems as the stimulus and focus for student activity (Baud & Feletti,1991). Research suggests that PBL may help students develop the skills necessary to pursue learning independently (Aspy, Aspy, & Quinby, 1993).

In PBL, instruction begins with the presentation of a complex problem situation and all learning occurs as a result of students' efforts to solve the problem. As students realize that they lack information necessary to develop a solution, they identify learning needs, then engage in self-directed study to meet those needs (Barrows & Tamblyn, 1980). During self-directed study, learners must sift through information, distinguishing that which is pertinent from that which is not. Yet, inexperienced problem solvers tend to focus on the surface features of a problem, failing to recognize what information is useful (de Jong & Ferguson-Hessler, 1986). Even in the field of medical education, both faculty and students have expressed concern that students may not be able to determine what should be learned (Barrow & Tamblyn, 1980). When attempting to use PBL with young learners, support for the development of self-directed study seems warranted.

Responsibility for this support can be left to the classroom teacher, but the extent and variety of supports needed can be overwhelming. One of the potential benefits of computer technology in educational environments is that it can share the responsibility for this support with the teacher. Collins (1991) argues that technology can offer good process models of expert performance embedded within the situations in which they are useful. The purpose of this study is to determine if the provision of hypermedia based models of expert cognitive processes can support students' work during self-directed study.

2. Research Questions

1. Does hypermedia delivered cognitive modeling affect students' use of a cognitive tool during self-directed study?
2. Do students transfer strategies taught through hypermedia delivered modeling to other tasks?

3. Design of Study

3.1 Sample

Two sixth grade science classes in a suburban school district in the southwestern United States participated in the study.

3.2 Treatments

Alien Rescue, a hypermedia PBL program dealing with the solar system, was used with both classes.

Two treatment conditions were developed. In the *cognitive modeling* treatment, the character of an expert scientist appeared in a video in the hypermedia program to model the cognitive processes she would use in collecting information pertinent to an identified learning need. In the *help* treatment, the expert scientist explained the function of the same tools used in the modeling treatment, but without modeling how she would use these tools to meet a learning need. Most students worked in pairs, though some worked individually.

3.3 Dependent Variables

Students' notebooks and a log of their tool access were used to examine the effects of the modeling on their work during a three day period of self-directed study. To examine transfer, a problem situation unrelated to the problem presented by the software was given to students at the end of the self-directed study period.

3.4 Data Analysis

The notebooks were analyzed descriptively for evidence of the effect of modeling during self-directed study. For the transfer measure, six relevant facts (needs) and ten irrelevant facts (non-needs) provided in the measure were identified. Students received one point for each relevant fact they identified, and one point for each irrelevant fact they did *not* include, and these were added for a total score. Three one-way ANOVAs were conducted with the needs, non-needs, and total scores as the dependent variables.

4. Results and Discussion

The descriptive analysis of students' notebooks showed differences in students' work during self-directed study. These results are summarized in Table 1.

	Cognitive Modeling	Help
Average number of words in notebook	207	188
Average number of times notebook was accessed in three weeks	73	63
Average number of meaningful sections created by 4^{th} day of study	4.1	2.8
Percent of notebooks containing evidence of lists	91%	25%
Percent of notes that represented relevant facts	68.6%	47.0%

Table 1: Results of Descriptive Analysis of Notebooks

For the transfer measure, the analysis of variance for the needs and total scores showed non-significant results, while the ANOVA for the non-needs score was significant ($F= 4.869$, $df = 1, 39$; $p < .05$).

The results of this study suggest that students' self-directed study is impacted by the provision of a hypermedia based tool in which an expert models the cognitive processes she would use, and that students will transfer skills modeling during PBL to other problems where they are useful. Of particular note, the results suggest that students who received modeling were better able to distinguish information useful in solving a problem from other, less useful facts. This suggests that problem-based learning software should be designed to include tools that provide expert modeling of the cognitive processes used.

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Developing Web-Mediated Instruction for Teaching Multimedia Tools in a Constructionist Paradigm

JoAnne Davies
University of Alberta
3-104 Education North
Edmonton, Alberta, CANADA
joanne.davies@ualberta.ca

Mike Carbonaro
University of Alberta
3-104 Education North
Edmonton, Alberta, CANADA
mike.carbonaro@ualberta.ca

Introduction

The University of Alberta's Faculty of Education has undertaken a restructuring process with the goal of better preparing teachers to effectively integrate technology into their teaching. A major component of this restructuring process is the development of a program of courses that make extensive use of Web-based technologies. This paper describes one course development project: the transformation of a traditional Lab-based instructor led course, on multimedia technology tools, to a "Wed-Mediated Instruction" (WMI) course that exploits various communication features of the Internet. The underlying goal of this transformational process was to preserve the constructionist learning environment (Nicaise & Barnes, 1996) of the traditional course while at the same time optimizing the course delivery mode to make it more accessible to a wider audience of students.

Project Overview

A course on multimedia in the classroom (Carbonaro, 1997) taught entirely in Lecture/Lab format was transformed by moving the course resource materials onto the World Wide Web (Web) and by making extensive use of Internet-based telecommunications. The course (now called EDPY 485 - Multimedia Tools for Teachers) employs what we like to call Web-Mediated Instruction (WMI). A course delivered by WMI is not necessarily delivered completely over the Internet, rather the Internet serves to provide resources and facilitate communication. Face-to-face (F2F) instruction and F2F student collaboration are still important components of our course. This allows for increasing student accessibility (Internet-based support) while simultaneously maintaining a constructionist collaborative learning environment that incorporates multimedia tools for creativity and problem-solving.

The Course

The theoretical considerations of the project resulted in the development of a course that made heavy use of hypermedia construction applications and Computer-Mediated Communication (CMC) which are viewed by Jonassen (1996) as superlative Mindtools. The course website (http://www.quasar.ualberta.ca/edpy485dev) provides a great deal of flexibility in that students can proceed through the course experiencing varying degrees of F2F instruction. Some students like to be helped in person, so they attend scheduled lab times. Others choose to work more independently, from home, work or wherever. Some students collaborate via telecommunications while others prefer in-person collaboration. Another factor in our particular course is that few students can afford the wide array of application software and peripheral devices available at the on-campus lab facility. This course requires that the students utilize special hardware and software including: scanners, digital cameras, postscript printers, video digitizing hardware, ZIP drives, and high-end video and graphic editing software. Thus, in our course, economics dictates that students must work on-campus for certain assignments. In any case, the website provides the information the students need in order to understand what is required of them to complete the course: course outline, schedule, list of required materials, explanation of assignments, marking criteria, tutorials, supplemental reading material, etc. The course requires that six modules be completed, they are: Internet tools, multimedia tools, digital poster, presentation software, hypermedia, and webpage construction.

The EDPY 485 course is continuously undergoing many changes to enhance the instructional environment. These include: (a) modifications to the Web-based resource center; (b) greater use of the Internet for course communication; (c) allowing greater choice in the time and location of instruction; and (d) improving the assessment of student performance. In particular, we have devoted considerable effort to developing the course website in support of course objectives. The course website is not just a syllabus representing the instructor's own perspective (Duchastel, 1997). There is a vast amount of educational material available on the Internet that is very useful to pre-service or in-service teachers. A website makes it easy to point the students to resource sites, and to Internet-based search tools which aid them in finding additional resources on their own. A lot of the information presented in this course is very dynamic. A website enables us to constantly enrich, update, and disseminate this information. The course website also enables us to easily show students exemplary models of previous students' work, which students can view whenever they wish, from any computer with Internet access.

Conclusions

After some initial offerings we obtained feedback from students via an online anonymous survey and from informal conversations. The survey was developed by adapting the online questionnaires currently in use in two other Web-based educational technology courses to assess students attitudes and course quality (Montgomerie & Harapnuik, 1997; Szabo et al., 1997).

Initial results indicate that we have largely managed to combine the best of these two very different worlds (both traditional F2F instruction and individualized Internet-based instruction). Students have appreciated the personal support offered by the traditional component of the course (particularly computer novices) and the flexibility and access to resources offered by the Web-based component. Hopefully, this course models how the needs of a wide range of students can be answered by supplementing traditional teaching methods with an individualized, self-paced component. For example, some students take the website and run with it, others like the instructor to accompany them on a slower walk through the course content. This course also demonstrates how a website can dynamically provide suggested resources to students and therefore models a WMI approach to learning and teaching. Student feedback indicates that the constructive, collaborative, student-centered nature of this course has proved to be a very engaging learning environment. There appears to be support for the idea that the incorporation of CMC into EDPY 485 furthers the Mindtools cause by providing teachers with a glimpse of how WMI technology can contribute to the creation of engaging and relevant learning environments.

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Using an On-Line Campus (OLC) in Teacher Education

Malcolm Ryan, School of Post Compulsory Education and Training, University of Greenwich, UK.
M.Ryan@greenwich.ac.uk

Simon Walker, School of Post Compulsory Education and Training, University of Greenwich, UK.
S.H.Walker@greenwich.ac.uk

Gary Culwick, Academic Development Group, University of Greenwich, UK.
G.Culwick@greenwich.ac.uk

Background

In 1995 the School of Post Compulsory Education and Training at the University of Greenwich piloted the use of Computer Mediated Communication (CMC) as an Enterprise in Higher Education project in support of the In-Service Distance Certificate in Education (Lewis, T., Gould, M., Ryan, M., 1997). The reasons for wanting to use CMC were to provide students with regular access to their peer group and tutors through conferencing and e-mail. A virtual learning environment was created using the groupware product, Lotus Notes (Ryan and Culwick, 1997). A customised desktop was created which included a set of virtual classrooms for each of the units of study, an electronic resource centre and student common room. We believed, and it was subsequently confirmed, that improved access would reduce the feelings of isolation often associated with distance programmes and provide opportunities for peer exchange and enhanced tutor-student interaction (Singletary and Anderson, 1995). Following the success of this pilot, the use of CMC as a support tool was offered to any distance student who had the necessary equipment and computer literacy skills.

It is our experience that those students and staff who are aware of and exploit the technology find it rewarding and beneficial to both their learning and teaching. If the use of information and communication technologies (ICTs) is integrated into curriculum thinking, planning and delivery from the start then we believe it is likely to be beneficial. Whilst providing a highly structured and integrated learning environment, a Notes desktop did not seem to be an appropriate technology when potentially large numbers of students (exceeding a thousand) would need to be supported within the newly validated Certificate in Education programme.

The New Certificate in Education

This new programme includes students who are studying a common set of units in full-time, part-time and distance modes. The majority of materials are print based and form the core of both content and mediation for all modes of study. We believe that tutor and peer support is fundamental to all teacher education programmes and ICTs are known to be effective delivery methods. It is important that students, tutors and mentors, remain up-to-date in their knowledge of relevant policies, practices and uses of ICTs in education and training. One way of addressing this is to integrate the use of ICTs, including hybrid CD-ROM technology, into the delivery of the new certificate programme.

Proposed Structure of On-Line Campus (OLC)

Building upon our earlier success in using Notes, a web-based, virtual campus has been established to support all students irrespective of mode of study consisting of:

- a Discussion Forum,
- Electronic Resource Centre,
- Student Common Room.

The Discussion Forum allows any registered student to pose a question, share an experience or ask for guidance. If they wish, tutors may set up activities to support the delivery of their unit that can then be accessed by students irrespective of mode (providing they have the skills/equipment). The Resource Centre can be used to store copies of files created by tutors in a range of software applications, (enabling easy access by both students and colleagues), and links to other web sites and OLC pages can be easily created for the benefit of all (Rohfeld and Hiemstra, 1995). The concept of a Common Room has been established as benefiting distance students and can provide opportunities for virtual, social interaction between students irrespective of mode, time or place (Mason, 1993; Moore, 1989).

One of the principles established by our use of CMC in support of Continuing Professional Development (CPD) programmes, is the need for a range of skills to be employed when designing and using an on-line environment. Consequently, this project draws upon the expertise of the Notes developer, the curriculum designer and the subject specialist. It is also intended that students, who are themselves a valuable resource (Knowles, 1990), will contribute dynamically to the content, nature and role of the OLC.

Training and Development

The need for staff and students to have the appropriate skills and confidence in order to exploit technology is well documented. A number of staff have experience of working with Lotus Notes and a growing number are able to 'surf' the web. A Notes desktop provides more features and greater control over the placing of documents and management of the discussion forum. It is envisaged that during this coming academic year all unit co-ordinators will be equipped with and supported in using Notes, enabling them to be more effective managers of and contributors to the OLC. Other staff and all students will access the OLC via a web browser. Training in the use of the web is already available to all centrally which will remove the problems previously associated with inducting even small numbers of students into the use of the Notes desktop.

What Next?

A major reason for employing an OLC at this time is that it allows us to promote the appropriate use of ICTs in the delivery of our teacher education programmes and to support colleagues in exploiting its potential. It is likely that IT competence will be a core component of future teacher accreditation schemes and we should prepare ourselves, our students and programmes to incorporate the technology strategically. As a relatively large scale pilot project we are interested in examining such factors as:

- the extent to which the learning community exploits the technology
- whether the mode of 'attendance' determines the use of the OLC
- what 'additionality' is brought to the certificate programme
- its cost effectiveness
- the merits of Lotus Domino as a web development tool
- the relationship between hybrid CD-ROM products and the OLC

Answers to these questions will help us to plan a longer-term strategy for the use of the OLC in support of other programmes from certificate to doctorate studies. This will form part of an integrated approach to the use of ICTs in teaching and learning which ignores time and distance (Berge and Collins, 1995) and focuses on quality and value.

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Challenges in the Design of a Hypertext Book in HTML: Lessons Learned

Earl R. Misanchuk
Extension Division
University of Saskatchewan
Canada
Email: earl.misanchuk@usask.ca

Richard A. Schwier.
Educational Communications and Technology
University of Saskatchewan
Canada
Email: richard.schwier@usask.ca

Elizabeth Boling
Instructional Systems Technology
Indiana University
USA
Email: eboling@indiana.edu

This document is a very brief summary of a larger paper and presentation. It is not possible to discuss the issues presented two pages, so we will restrict ourselves to providing an annotated outline of the topics here, and invite you to download the larger document. More information about the hypertextbook Visual Design for Instructional Multimedia, including previews of most sections of the book, is available from http://members.home.net:80/m4.multimedia/. A complete version of the paper, presented earlier this year, is available for downloading as a PDF file [190 KB] from www.extension.usask.ca/Papers/Misanchuk/EDMEDIA99/EDMEDIA99paper.pdf.

Large-scale hypertext implementations designed to provide information are common enough (especially as websites); however, large-scale instructional equivalents are, at this juncture, more rare. The complete paper and presentation include the following:

- Description of the design and development of a CD-ROM-based hypertextbook, entitled Visual Design for Instructional Multimedia, which consists of more than 3,100 HTML, JPEG, GIF, and MOV files
- Morphology of the project through several stages, highlighting issues arising from developing the product with HTML rather than with a more hospitable authoring program
- Description of a number of things we learned from the "school of hard knocks"—some profound, some mundane—in the hope that by sensitizing you to some of the problems we encountered and decisions we made (and sometimes re-made), we can help you avoid some of the pitfalls we encountered.

Outline of the Paper and Presentation

Need for the Book
Content and Scope.
Structure

The "modified linear" design
Mainstream text and diversions

- reference citations
- examples
- elaborations
- navigation links

Diversions from diversions
Orientation and location cues

Process

Getting started
The distance factor
Working together and apart
The overall process

Work Methods

Pages on the Fly
Document First, Pages Later
Outline, Just Like Mr. Hankel Says
The Traditional Book Publishing Approach

Design Issues

Settling on a Visual Design
- The impact of technology on design options and the design process.
- The impact of usability testing and technology on navigation design.

Navigation Schemes and Screen Geography
- Hypertext advantages with simple navigation.
- Linking to the same page from different locations in the text
- Image map menus vs. frames
- Cues for different types of links

Academic Writing and HTML
- Formality of language.
- Editorial issues.

Web or CD-ROM versus Print for Distribution
- Why not a printed book?
- As long as it's electronic, why make it essentially linear?
- Why HTML instead of another authoring environment?
- Why then, a CD-ROM and not the Web?

Expert Review and Usability Tests

Concerns of Designing Distance Learning Environment

Yahya Mat Som
Occupational Education Studies
Oklahoma State University
Email: yahya_matsom@yahoo.com

Dr. Amy Sheng Chieh Leh
Department of Science, Mathematics, and Technology Education
California State University San Bernardino.
Tel: 909-880-5692, E-mail: aleh@csusb.edu

The current education scenario appears to place the Internet as a timely tool for educators who are interested to reform education delivery (McLain & DiStefano, 1995). The technology sophistication, compatibility and user friendliness to education environment makes education more accessible from distance. In fact learners may receive academic degrees without stepping on university ground. In addition, Kinner and Coombs (1995) found that utilizing computers in the classroom can reduce communication barriers and facilitate interaction among learners that are inhibited in the traditional classroom. However, the differences between classroom instruction and computer-based learning are very significant (Steinberg, 1991), therefore educators should address the issue very carefully. If it is planned, designed and executed correctly, and learning can be placed in a meaningful context, then the learners will be actively engaged in the learning situation (Bridges, 1992).

This paper will report concerns for conducting on-line courses, including instructional format, methods of instruction, methods of interactions, methods of communication, instructional media, and participants. It will address some of the concerns when conducting an on-line course. The intention is to share the information, recognize and realize the challenges for professionals to be better prepared for the electronic learning environment.

Instructional Format

Using the traditional class instructional format such as preparation, presentation, application, and summary may be considered for an on-line course. However, its affect on student's concentration, motivation, thought, mastery, and comprehension (Verduin &Clark, 1996) could be a big challenge without the right strategies to transfer classroom activities into on-line activities. Among these factors, on-line educators are most concerned about the assessment process, especially when looked at in the context of traditional classroom environment or exam oriented learning formats regarding the validity of student's works.

Methods of Instruction

Brookfield (1985) contended class facilitation will promote greater student involvement in the learning process when compared to lecture method. However, in an on-line environment the method can be very challenging, especially when students have different learning styles. The factors that determine how, what, and when to interact are the most critical factors to be addressed in order for the teaching and learning to be efficient and effective.

Methods of Interaction

In an on-line environment the discussion, group work, and question-answer sessions can be accomplished by means of both asynchronous and synchronous modes. Anderson (1993) discussed these factors for effective, successful teaching and learning in a classroom. However, the absence of physical presence in an on-line environment makes the execution of such factors more challenging, especially when much of the success of the on-line delivery method using these factors depend on both the capability of computer system and software, and the ability of the instructor to manage the class effectively.

Method of Communication

In a traditional classroom visual, verbal and non-verbal communications are readily integrated in the teaching and learning process to express the meanings of actions, words, and texts (James & Blank, 1993). Cochenour (1994), however, explained the difficulty to integrate these factors in electronic environment such as on-line course. There are many variables that have to be considered for the integration to be successful such as capability of system networks, students' and instructors' computers, software, and course design.

Guest Speakers

In a traditional classroom instructor, students and guest speakers are common participants (James & Blank, 1993). On the contrary, in on-line environment, guest speakers are absent. Among the reasons are, they have to face the challenges of learning computer operation skills, managing the software, availability of time, log on process and so on. Their involvement is more difficult when the primary communication strategy is mainly based on text like the asynchronous mode of delivery. The lack of or no physical contact, facial expression, and social cues that could promote normal relationship as in the traditional classroom will contribute further to the absence of the guest speaker in an on-line environment.

Instructional Media

Miller and Clouse (1993-1994) contended the role of technology is significant to disseminate primary course information in the education settings. It can be applied as the main instructional strategy or as a supplement to enhance learning and teaching. In an on-line course the use of technology is a must. However, finding the right technological tool to enhance learning and teaching can be very challenging. Among the variables that have to be considered in the selection process are the capabilities of the system networks, end user machines, compatibility and accessibility of software, support personnel, and policy. These will determine to what extent media can be used to conduct communication, interaction, and instruction.

Conclusion

This shift of new education paradigm with regard to the advance of technology is altering educators' perceptions about teaching and learning strategies. Many educators are involved with the new paradigm of teaching. The concern of (1) using appropriate instructional format, methods of instruction, methods of interactions, methods of communication, and instructional media, (2) encouraging participants' involvement, and (3) requiring the correct strategies should be the primary issues for on-line educators. Some questions have been answered but many are still unsolved. Educators should share their ideas with their colleagues and continue the debate for a better practice.

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Implications of the Electronic One Minute Paper

Steven Hornik
Department of Accounting and Information Systems
Xavier University
United States
hornik@xavier.xu.edu

The One-Minute Paper (OMP) has been used to generate feedback to instructors for some time (Harwood 1996; Ludwig 1995; Kloss 1993). Traditionally this has involved having students spend a few minutes at the end of a class session writing down what was understood and what was still unclear from a particular classroom session. Bryan et al. (1993) reported that instructors had favorable perceptions about the timely feedback of OMP's obtained from accounting courses. In addition to providing feedback, the cognitive effort that is required by students to complete the OMP has been shown to positively effect learning under certain conditions. Bryan et al. (1993) reported that students from various accounting classes reported a perceived augmentation to learning as a result of the OMP.

Although the empirical effectiveness of the OMP are sparse some studies do indicate a beneficial relationship between the preparation of an OMP and learning. Almer et al. (1998) has shown that accounting students completing an OMP performed significantly better on quizzes than students who did not complete the OMP[1]. Similar results have been found with economic students (Chizmar and Ostrosky 1998) studying microeconomics.

The OMP is typically performed in class, at the end of a lecture. This research will examine what effect if any will endure by having students complete their OMP electronically (or electronic OMP) some time after the class lecture has finished Having students complete the OMP electronically can change the nature of the OMP in several ways. First, if students do no have access to a computer in the classroom for which the OMP is to be completed the benefit of the immediate recall of the class contents may be lost. However, an added benefit of completing the electronic OMP (or e-OMP) is that the students' e-OMP can be made available to other students, thereby providing students with feedback similar to what an instructor would receive from a traditional OMP. In addition, the e-OMP lends itself to the possibility of having students provide comments and/or explanations to other student's e-OMP about unresolved questions. In other words the e-OMP can become a virtual component of class discussions in which students from a class can post questions about areas that they do not understand and have their fellow colleagues help them by providing explanations.

Numerous questions stemming from the use of the e-OMP can be formed. The first, will the cognitive effort used in completing the e-OMP result in better performance? Also, will the e-OMP completed up to a day after a class session, be as useful as the e-OMP completely shortly after class? The second, what effects will collaboration have on learning within the OMP framework? That is, will students who have responded to an e-OMP with helpful suggestions outperform students who have only completed the e-OMP without responding to any fellow students? Third, will the e-OMP have distinct effects depending on exam type (multiple-choice, problem solving or essay)?

Experimental Procedure

The e-OMP data presented here was gathered during the fall 1998 semester from 54 MBA students[2]. The e-OMP was implemented using Learning Space and Lotus Notes. Students were told that the posting of e-

[1] Further analysis by Almer et al. (1998) indicated that the benefit of the OMP was only significant for essay-type quizzes vs. multiple-choice type quizzes.

[2] The students were from two separate *Financial Statement Analysis* classes. One of the groups was from an off-site MBA program. Analysis of the two groups indicated no significant differences between them so the results from the two groups are combined.

OMP would be anonymous, but that if any inappropriate comments were posted the person responsible could be determined. The e-OMP contained the following questions: 1) *I am most confused about the following point that was brought up in class tonight; 2) If there is one thing I completely understand now, it is the following:; 3) I would like to learn more about the following topic:; 4) Finally, please rate your perception of understanding for this weeks materials: Got It!, On my way to getting it, or Oh boy I'm Lost*[3]. The response to the e-OMP was worded as follows: *I believe that if you consider the following points, it might help clear up your confusion.* The response to the e-OMP was not anonymous and was used in the determination of the overall participation grade for the student.

Data Analysis

To examine the relationship between the e-OMP and student performance the students overall grade (scored on a 1000 point scale) was divided into its component parts: exams and mini-cases. Pearson correlations were run to determine any relationship between these components (and their totals) with either the e-OMP or the responses to the e-OMP. Results indicate a positive relationship between the e-OMP and students total overall grade (.378, $p<.005$). With respect to the e-OMP response, results indicate a positive relationship between the response and students overall score[4] (.569, $p<.000$), the total exam score (.349, $p<.01$), and the combined exam and mini-case score[5] (.389, $p<.004$).

Next ANOVA was used to examine if the differences among the students' performance could be attributed (in part) to the e-OMP or responses to the e-OMP[6]. The results indicated that even though a significant positive relationship existed between the use of the e-OMP and overall student performance there were not any significant differences that could be ascribed to the number of e-OMP completed. However, the results indicate a significant difference between the number of responses to the e-OMP and the total exam score ($F=2.382$, $p<.064$), the combined exam and mini-case score ($F=2.934$, $p<.03$) and the overall score ($F=7.619$, $p<.000$). Post-hoc analysis on the overall score indicated a significant difference between 0 responses and any response (either 1,2,3 or 5 responses). Of practical importance the differences were as follows: 5 responses: 122 points ($p<.001$), 3 responses: 103 points ($p<.000$), 2 responses: 63 points ($p<.039$), and 1 response: 51 points ($p<.034$). Post-hoc analysis of the combined exam and mini-case score also indicated a significant difference between 0, 3 and 5 responses. These differences were as follows: 5 responses: 63 points (p<031); 3 responses: 51 points ($p<.019$).

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[3] This last question was implemented via a check-box on the e-OMP.

[4] The overall score includes points for participation, which were partially based on completion of e-OMP as well as the responses to the e-OMP.

[5] This score does not include the participation points.

[6] The mean and standard deviation of the e-OMP were 6.9 and 3.1 respectively. The minimum number of student responses to the e-OMP was 0 and the maximum was 5.

EPSS in the Classroom: Self-Management Tools for Kids

Gail E. Fitzgerald, Patricia Watson, and Jennifer Lynch
School of Information Science and Learning Technologies
University of Missouri—Columbia, Columbia, MO 65211, USA
spedfitz@showme.missouri.edu, ciwatson@showme.missouri.edu , jlynch@coe.missouri.edu

Louis P. Semrau
Department of Special Education
Arkansas State University, State University, AR 72467, USA
lsemrau@kiowa.astate.edu

Introduction

In a recently developed series of training materials designed to help school personnel work with youngsters with behavioral problems, *Teacher Problem-Solving Skills in Behavioral Disorders*, interactive multimedia case studies were combined with electronic performance support system (EPSS) tools for teachers. Funded in part by a grant from the U.S. Department of Education (Semrau & Fitzgerald, 1993-1997), the goal of the project was to develop interactive training programs to enhance problem-solving skills of teachers to better serve children with social, emotional, and behavioral difficulties. Through authentic, case-based problems, users learn to plan therapeutic instruction, design behavioral interventions, and create cognitive-behavioral intervention materials to teach children self-management procedures (Fitzgerald, Standifer, & Semrau, 1998).

To supplement the training materials for educators, initiatives are underway which attempt to extend the real-world use of the training materials by developing a companion series of EPSS software programs for children to use in classroom settings (Fitzgerald & Semrau 1998). The software programs for kids are compatible with the cognitive-behavioral strategies in the instructional materials for teachers. The self-management materials provide a set of electronic tools that children and youth can use to create their own behavior plans for self-management. By helping children take responsibility for their own behavior, internal controls for behavior are established and the need for external control of behavior are reduced.

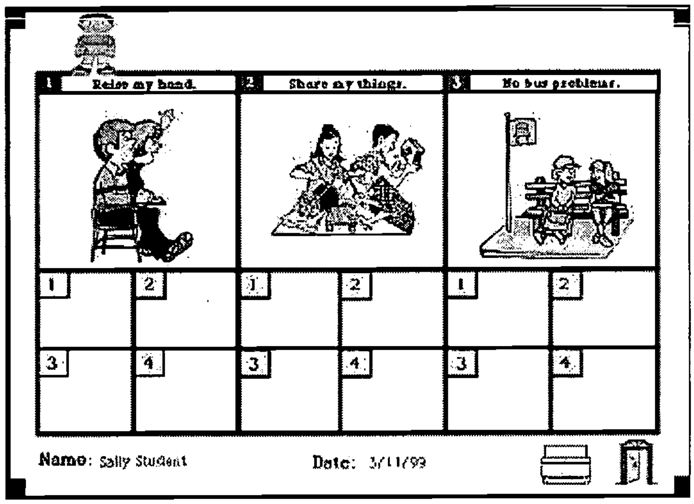
Computer-based training and support mechanisms are an innovative approach for helping students gain control over personal behaviors. Although there are limited data on the use of computer-based instruction to support behavior change in students to date, research results are promising. Fitzgerald and Werner (1996) reported success with a computerized verbal mediation essay as a cognitive retraining procedure to assist a student with significant behavioral disorders in changing his behavior; the computerized essay provided consistent practice and focused the child's attention and thoughts on behavioral choices and consequences. In another case study, the same researchers reported a procedure in which software templates were developed for a student to create self-monitoring materials. This study was the pre-cursor to this work to develop and investigate the use of EPSS tools with children.

Instructional Design of Program

The EPSS programs are designed as easy-to-use templates that can be individualized by children and/or their teachers. To use the templates, the child simply clicks on "hot words" on the template form to enter personalized content and then print it for use in the classroom. The program automatically enters the child's name, the date, and establishes a datapath for recordkeeping purposes. When complete, the templates will be appropriate for youngsters at two levels: elementary and middle school/junior high. The programs are created with *Authorware 4* and operate on both Macintosh and Windows platforms.

KidTools incorporate several literacy-related design features to make them suitable for children's use. The teacher tools were modified, making the templates child friendly and incorporating the use of natural language of children. Graphic characters were added to serve as "guides" to the different tools. Audio support now supplements simplified text instructions.

The following graphic displays an example of a KidTool. This is a *point card* for monitoring success on three behaviors. The child selects pictures from a graphics library to represent the behaviors. Each behavior is given a simple descriptive name. The monitoring grid is printed on the card to allow the child to monitor success on the behaviors four times during the school day.



Formative Evaluation

Teachers from three elementary schools in rural and urban areas in Missouri participated in designing and evaluating KidTools. A small cadre of teachers in each building shared the materials with interested teachers and contributed suggestions for template adaptations as well as additional forms needed in their schools. Project staff observed children's use of the software using think-aloud techniques. User datapath records were examined to determine common template usage and to gain samples of natural language from children. At the close of the school year, interviews were conducted with teachers who implemented the materials. Based on formative evaluation data, KidTools will be revised during the summer months for full implementation in the schools during the 1999-2000 school year. Recommendations will be forthcoming regarding effective implementation of EPSS tools with elementary-age youngsters.

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The Wake Forest Strategic Plan for Technology

David G. Brown, International Center for Computer Enhanced Learning
Wake Forest University E-mail = brown@wfu.edu

All incoming Wake Forest University freshmen students receive new laptop computers upon entering, exchange them for a more powerful laptop upon returning for their third year, and take their second computer with them upon graduation. In Fall 1999 the computer will be the IBM Thinkpad 390 with Pentium II, 333 Mhz, 6 GB Hardrive, 128MB Ram, 4.1" active matrix screen, DVGA video, ethernet, and CD Rom. Standard software will include Windows 98, MS Office Professional 97, Netscopae 4.5,Dreamweaver, SPSS 9.0, and Maple V5.1.

All Wake Forest faculty and staff are on a two-year refresh cycle. All students, faculty, and staff therefore have 24-hour, 365-day, worldwide access to one of two standard computers with standard software packages. Standardization enables round-the-clock staffing of knowledgeable help desks, coaching by roommates and office neighbors, loaner pools, and (most meaningfully) teaching with the knowledge that all students have access to powerful electronic tools. The methods students learn for one class (e.g. creation of a web page) are transferable to other classes and to all types of community activities (e.g. fraternities and special interest clubs).

This ubiquitous computer environment has transformed the quantity, quality, and character of teaching, learning, and campus life. Frequent surveys confirm that more students are more intensely involved with more subgroups over more months, even when subgroup members may be farther apart. Surveys show that faculty are in touch with more students more frequently, as well as with more professional colleagues in more countries and for more years. The capacity for network conferencing, for sharing videotapes, for synchronous and asynchronous threaded conversations, for sophisticated archiving and indexing of messages, and for random access of images now contributes to a much, much richer community of learners. Students in a freshman writing course exchange rough draft essays with a similar class in Canada. Shakespeare students participate in fortnightly, live, two-way video conferences with the archivists at London's Globe theatre. Business students view and review cyber-lectures so that class time can be reserved for discussion and analysis.

Because Wake Forest was one of the first to implement a ubiquitous computing program, we have been visited by individuals and delegations from over 300 U.S. colleges and universities and over 40 colleges and universities in other countries. In Winston-Salem, Southeast Asia, and Europe we have been sharing "the Wake Forest Story." Our intent is to catalyze other institutions to implement ubiquitous computing for the benefit of their students. This story includes a multiyear financial plan, the steps followed toward achieving faculty and trustee votes for a standardized computer initiative, faculty development initiatives, printer and network strategies, etc.

In COMPUTER ENHANCED LEARNING (http://iccel.wfu.edu) nineteen leaders of the implementation have collected this list of lessons learned:

- PC's are only 10% of the Challenge (support/networks/policies/train/expose)
- Most sunk costs can be ignored
- Expectations need management
- Develop a comprehensive plan first, and quickly match it with a multiyear financial plan
- Standardization pays rewards well beyond those anticipated; non-standard configurations require 3-4 times support
- Students/Faculty want specific computer training that is centered around a task-at-hand; general classes don't work well
- Be prepared to outsource challenges
- Reliability is critical, especially the Help Desk
- Provide academic units staff of their own & plenty of equipment without hassle
- Defer wiring every seat and every classroom
- Provide printers to every student
- Adopt a common course shell
- Avoid mandating the use of computers by all faculty
- Insist upon at least a three year refresh rate
- Improve communications weekly; rumors fly faster
- Spread the gains from & ownership of innovation throughout all units

This beginning list is cited for the purpose of catalyzing a sharing of lessons learned by other early implementers of ubiquitous computing, and thereby enabling others to avoid some of the missteps others have made.

Faculty Development Strategies

David G. Brown, International Center for Computer Enhanced Learning
Wake Forest University, USA. Email = brown@wfu.edu

One of the last, yet most important, stops along the road to utilizing powerful and newly available multimedia technologies is motivating and training the nation's faculty. Now, more than at any time in the last fifty years, the academic disciplines are focused upon quality teaching. Faculty must be encouraged to start with their educational objectives and their successful learning experiences, and then consider how technology might allow the pursuit of these objectives in more effective ways. In this "teachable moment" we must efficiently provide faculty with the ability to use an array of new tools--- from downloading clips from the internet, to accompanying lecture-discussions with PowerPoint slides and creating animated videos to illustrate difficult-to-understand concepts.

The infrastructure must precede everything. A first challenge faced by faculty development specialists is assuring access to appropriate computers. To be fair, all students must have easy and equal access, and faculty will insist upon fairness before they ask students to rely upon computers. Equally important is a reliable network, for without it faculty will have to prepare failsafe assignments which means double-work. Classtime is too precious to risk losing.

A second challenge is assuring access to appropriate advice. Required is "just in time" training when there is a "need to know." Alternatives include subsidized summer workshops, special classes available upon demand, computer-based training modules, well-trained help desk personnel, course designers, and single-purpose seminars. At Wake Forest we have come to rely most heavily upon STARS (well-trained students assigned for semester-long periods to help individual faculty members incorporate computer enhancements into their teaching), Academic Computer Specialist (Ph.D.'s in the discipline hired by departments to spend full time helping departmental colleagues design and implement computer enhancements in their teaching and research), and RTAs (trained students residing in residence halls and available for face-to-face consultation especially in the evening). .

A third challenge is motivating faculty to make the time to learn how to use these new tools. While assuring faculty that they will not be penalized for deciding against the use of computer enhancements in their teaching, multiple programs encouraging exploration are essential. Some of the most successful programs are release time grants, summer fellowships, technology fairs, innovations awards, and collecting information about teaching innovations in conjunction with promotion and tenure decisions.

A fourth challenge is dissemination strategies, especially sharing information about successful adoptions. Swap and share seminars, benchmarking trips, guest lecturers, subsidy for attendance at national computer meetings, computer-assisted learning newsgroups, and "computer tip talks" by students are among the more successful programs for dissemination.

The real key to success is a faculty culture that supports experimentation and encourages each faculty to do his/her best for the students. Such a culture is most likely to thrive when most faculty are using technology in some way, and when colleagues can share knowledge.

Nothing is more important than keeping it simple! By shortening faculty learning curves and standardizing campus practices, widespread adoption is greatly accelerated. Specifically, two practices are advocated:

1. When possible, standardize. Enable all students and faculty to use the same machines, hardware, and software. Friends and neighbors will teach each other. Once a crisis is fixed for one machine, it may be applied to all. Once a student learns how to use the computer in one class, the knowledge is relevant for the next. The negative consequences of physical breakdowns can be minimized by backup systems. Training is greatly simplified.

2. Emphasize "high benefit- low cost" uses of the computer. Specifically, train faculty to use the computer to improve communication, both instructor-student and student-student. Encourage the use of group e-mail, URL citations, and course web pages. At first, discourage the time-consuming development of on-line exercises and of fancy visualizations. That can come later.

The nation's faculty is eager to do well by students. Strong networks, early successes, and standardized systems can be the backbone for effective dissemination strategies. It will not be long before courses without computer enhancements will be as unfamiliar as courses without textbooks. The faculty is ready! The students are there!

Exploring Curriculum Delivery

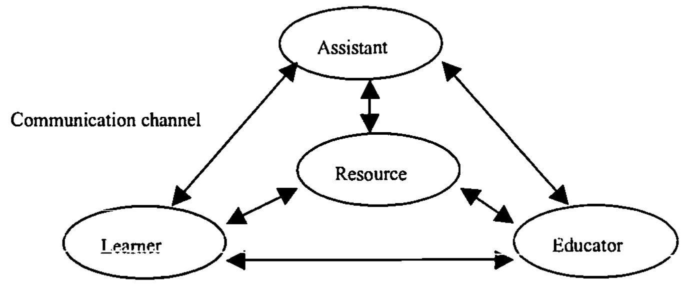
Yanlu Xu
Wrexham Business School
North East Wales Institute
United Kingdom
xuy@newi.ac.uk

Three Parameters of Curriculum Delivery System

This paper reports on an attempt to conceptualize curriculum delivery within the framework of new technology. When we analyze the differences of curriculum delivery in a social context, we see there are three main parameters that strongly influence the curriculum delivery paradigm. These parameters can be set into a social context along with human history either vertically or horizontally. The three parameters are *knowledge, pedagogy, and technology*. First we discuss the three parameters in a vertical time dimension which represents human history. *Knowledge* based on human beings' understanding of the real world has developed as different self-contained disciplines, such as: physics, medical science, chemistry, social science, engineering, computer science. The different disciplines nowadays have much more to offer their learners than in the past due to the development of the disciplines themselves. Knowledge is the basis of any curriculum delivery system. It is the content of delivery and it affects the richness of the curriculum delivery system. Another parameter is *pedagogy* and we conclude that the present curriculum delivery system in education puts much more effort into pedagogical issues than before. Educators are concerning more about how students learn and, consequently, how they themselves teach. Many institutions have set up instruction design centers to improve and enhance curriculum delivery. Pedagogy has been paid much more attention as the discipline has matured. This parameter affects the flexibility and reflects the methodology of curriculum delivery. The third parameter is *technology*. This has had considerable influence in the past and we can project an immense future impact on curriculum delivery. Projects such as China's TV University and the UK's Open University are both good examples of technology bringing new ways to teach and learn. Future technology will allow us to provide a more open and flexible curriculum delivery system. Now we consider those three parameters in a horizontal dimension. A horizontal time dimension implies the same point in history and the same society. We could see that different institutions might offer different standard curricula at the same historical point. Thus Harvard University might offer better management curricula than others do. In other words even if we consider the same historical point, institutions have their own practice in the context of the three parameters. The knowledge parameter reflects the capabilities and experience of staff. The technology parameter represents the extent of use of teaching technology. This can include such things as multimedia curriculum delivery, online Internet platform course delivery, CNC distance learning and ITV distance learning. At one extreme some institutions may have not even have started the use of transparent slides! Finally, the pedagogy parameter affects the effort an institution puts into its instructional design. The ones that put in more effort should have better outcomes for their curriculum paradigm than others that have perhaps put in less effort. There are a number of articles arguing that we should pay more attention to pedagogy, but how can those pedagogical issues be integrated into instructional design along with the use of technology? This remains unclear. Overall, with these three parameters we can build a three-dimensional paradigm of curriculum delivery that can reflect its current standing.

The CLEAR Curriculum Delivery Framework

We have concluded that we can construct a curriculum delivery paradigm with these three parameters. The CLEAR framework (see the figure below) offers guidance on *how* to make this system work. It is a mechanism that can provide an open and flexible access and approach to curriculum. And it has been designed keeping these ideas in mind. In the CLEAR framework there are five basic components, namely, *Communication channel, Learner, Educator, Assistant, and Resources* (CLEAR). Four of those components are based on an initial investigation (Xu, 97) of the current framework of the Wrexham Business School. The *assistant* component was derived from a literature review.



The CLEAR Framework

In the framework figure, the lines indicate the communication channels. The bubbles indicate the other four components. The *communication channel* component (also referred to as the 'knowledge transfer routine') always links any two of the other four components together. When the five components are set into one framework and if somehow the resources transfer routine can reflect the openness and flexibility of access to the curriculum, it is not hard to arrive at the conclusion that the traditional approach has very little openness and flexibility for the learner. This is because in the traditional process, the educator draws knowledge from the resource, and mediates mainly by face to face communication in transferring knowledge to a learner. In the CLEAR framework, the knowledge transfer routine has been expanded by added the role of an assistant into the delivery system. Also the communication channels mean more than just face to face communication in the CLEAR framework. They also include all the possible communication methods relying on advanced technology. In consequence the resource becomes richer and easier to access in the sense of content and format due to the contribution of the assistant, the learner, and the educator.

Future Research

In comparison with traditional methods, the CLEAR framework can provide more opportunities to learners, since it sets curriculum delivery into an open and flexible framework by adding transfer routines and communication channels and it also enriches the format of knowledge resources. However, it is admitted that these goals can be achieved only if we can find ways to take advantage of technology, because the framework relies heavily on the use of advanced technology. Therefore future research in this project aims at developing a suitable technology platform. Currently the links between technology and the five components are being mapped. The components of educator, learner, assistant, and resource will centralize on their own roles in the system, and the communication channel will maximize the possibility of assisting their different roles. The main activity for the educator is to facilitate, for the learner it is to explore, for the assistant it is to cooperate and for the resource it is to be retrievable. The communication channel will have a key role in extending and supporting the system functionally. The system will be implemented into an object-oriented paradigm of the methodology of software development. The roles played by educator, learner, assistant, and resource can all be integrated as objects and attributes into the system by different communication methods to interact with the system. This work will be reported in more detail at a later stage.

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Arthur: An Adaptive Instruction System Based on Learning Styles

Juan E. Gilbert
University of Cincinnati
Department of ECECS
United States
juan.gilbert@uc.edu

C. Y. Han
University of Cincinnati
Department of ECECS
United States
chia.han@uc.edu

Introduction

Learning styles are approaches to learning and studying (Dunn, 1987). We all have learning preferences, which enable us to learn more effectively. When introduced into a learning environment that supports our learning style(s), learners have a higher level of understanding the material. The learning styles theory implies that how much individuals learn has more to do with whether the educational experience is geared toward their particular style of learning. In a traditional classroom environment, there is one instructor and several learners, which is an one-to-many relationship. The instructor presents information with his/her personal style of instruction. If the instructor's style of instruction is conducive with the majority of the learner's learning style, then the class as a whole will perform well. In the general case, the instructor's style is conducive with most of the learner's, but not a perfect match. In this case, the majority of the class will have an average performance with fewer people doing either very well or very bad, which establishes a bell shaped grade distribution.

Imagine a classroom full of instructors and only one learner, which is a many-to-one relationship. Each instructor is an expert in the same field of study, but each uses a different style of instruction. Hence, the learner's chances of doing well in this classroom would appear to be significantly better than in a classroom with one instructor because each learner would adapt to the instructor(s) that would facilitate his/her learning style. In the sections that follow, we will introduce an implementation of the many-to-one relationship.

Arthur

We have developed a web based instruction system that provides adaptive instruction, Arthur. Arthur takes several different styles of instruction from several different instructors and makes them available to each learner, which defines a many-to-one relationship. A group of instructors with different instruction styles from the same field collaborate to create a course map, which is similar to a syllabus, for the course content. The course map is divided into small sections that are called concepts. A concept is a basic unit of instruction or a fundamental concept that must be covered within the course. In a traditional class, the topics that are listed on a syllabus would be considered course concepts. After creating the course map, each instructor will create a web deliverable course module, using their own personal instruction style, that adheres to the course map. Upon completion of their individual course modules, each instructor will add their course information into Arthur via the web. This creates an instruction pool of course modules accessible from the world wide web. Each course module represents a unique method of delivering instruction via the web utilizing a different instruction style. Upon entry into the system, learners will be assigned course modules from the instruction pool.

Learning Experience

When a learner enters Arthur using a login and password, Arthur will deliver the first concept of one of the course modules from the instruction pool. The courses are initially selected at random. Therefore, each student will be assigned their first course module by chance. Each concept is terminated by a short evaluation quiz entered by the instructor. Learners will take the quiz at the end of each concept. They are expected to pass each section with a score of eighty percent or better in order to continue within the current course module. This evaluation method introduces the term *Mastery Learning*, which is used by Arthur to adapt the instruction style.

Adapting Instruction

Mastery Learning is based on the assumption that, given enough time and proper instruction, most students can master any learning objective (Bloom 1968). The normal distribution of scores learners exhibit on any performance test arise from the use of one instruction style given by one instructor and the practice of holding instructional time constant for all students and allowing learning to vary. Bloom (1976) suggest that learning should be held constant and time allowed to vary. Arthur uses mastery learning to adapt instruction for each learner. When a learner completes a quiz at the end of a concept, Arthur employs mastery learning to adapt the instruction based upon the learner's score for each quiz. If the learner scores 80 percent or better, Arthur will allow the learner to move onto the next concept using the current course module. Otherwise, Arthur will force the learner to repeat the same concept under a different course module, which utilizes a different instruction style.

Conclusions

The theory of learning styles states that people have different approaches to learning and studying (Dunn 1987). Several studies show that there is "No Significant Difference" when technology is applied to instruction (Gerhing 1994, Goldberg 1996, & Moore 1996). The most commonly used instruction environments use an one-to-many or one-to-one instructor/learner relationship. We have developed an environment that utilizes technology to deliver a many-to-one instructor/learner relationship. Before the recent use of technology, this type of education experience would have been too expensive to implement. Using the world wide web and supporting technologies, we can deliver a many-to-one instructor/learner relationship such that individual learning styles can be accommodated.

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Web-Based Learning Environments in Action: The Search for Luna, A Nautical Archaeology Expedition

Karen L. Rasmussen, Ph.D.
Professional Studies and Technology
University of West Florida
Pensacola, FL 32514
krasmuss@uwf.edu

Pamela T. Northrup, Ph.D.
Professional Studies and Technology
University of West Florida
Pensacola, FL 32514
pnorthru@uwf.edu

Janet K. Pilcher, Ph.D.
Professional Studies and Technology
University of West Florida
Pensacola, FL 32514
jpilcher@uwf.edu

Introduction

Web-based learning environments can offer learners an opportunity to participate in real-world, authentic situations that can provide them with exciting learning experiences. Anchored, authentic, and situation learning environments such as MayaQuest, Net-Frog, Jasper Woodbury, and Voyage of the Mimi, provide learners with a unique opportunity to participate in complex-real world learning experience. In these learning environments, learners collaboratively participate in experiences within meaningful contexts to permit the learner to become independent and develop problem solving and reasoning skills that can be transferred to other situations. Learners participate in activities to develop skills that involve the analysis, synthesis, and evaluation of information and strategies used to solve a wide variety of problems (CTGV, 1990). In turn, learners help define and refine the learning environment to create a multi-dimensional microworld.

Reform and accountability measures across the nation have challenged teachers to alter the ways in which they teach (e.g., SCANS, Goals 2000). Integrated curriculum and technology-rich learning environments meet these challenges. In Florida, responses to these measures are seen in the Florida Sunshine State Standards which describe skills that students should attain in eight subject areas (in four grade level clusters PK-2, 3-5, 6-8, and 9-12): Language Arts, Mathematics, Science, Social Studies, the Arts, Health and Physical Education, and Applied Technology. Both national and state standards involve a wide range of high-level outcomes that require students to work cooperatively to solve problems, apply solutions, and reflect upon their experiences.

Development of the Learning Environment

The Search for Luna was anchored around the framework of an Archaeological Field School. A team of professional archaeologists, elementary school teachers, instructional designers, and technology experts worked together to develop and implement the expedition. In Northwest Florida, there is a rich archaeological tradition, both on land and sea. Nautical archaeologists have found and excavated a sixteenth century Spanish ship in Pensacola Bay and believe that there are six additional sunken ships still to be found. Field School participants worked with archaeologists to make meaning from artifacts of the current find and assist in the exploration for and excavation of other ships. Two major themes guided students through the expedition experience: Become an Archaeologist, and The Expedition Challenge.

In "Become an Archaeologist," Field School participants learned the basics of becoming an Archaeologist through four thematic weeks: 1.Exploration, Immigration, and Colonization (History), 2.How Does Archaeology Help Us Learn About Our Past (Searching), 3.What's the Scientific Method? How Do Archaeologists Use It? (Excavation), 4.What Happens to Artifacts? (Conservation). For the Expedition Challenge, learners were encouraged to form an expedition team and plan, organize, and pretend to carry out their own expedition to explore and colonize a new territory. For both the Field School and the Expedition Challenge, learners were encouraged to collaborate with other learners throughout the State of Florida through a Share Network.

To support the constructivist nature of the learning environment, extensive resources were available to the participants. Learner resources were required to develop the necessary knowledge skills to solve the designated problems (Wilson, 1996). The Field School resources, for learners, included: an Artifact Database, Glossary, Web Sites, and Books. These resources formed the background materials that learners needed to answer expedition problems. To help teachers during the experience, materials were also available to provide assistance such as additional resources, sample in-class activities, and assessment and data collection techniques. Teachers also had access to a sample model unit, available through the EPSS, STEPS, that outlines standards alignment, integrated curricular activities, resources, best practices, and technologies that can be used in a Nautical Archaeological Unit (Northrup, Pilcher, & Rasmussen, 1998; Support for Teachers Enhancing Performance in Schools, 1998). Teachers were kept up-to-date on expedition status through online newsletters. All teachers were part of a listserv that was used for group communication.

Implementation of the Learning Environment

The expedition, which consisted of both live and simulated elements, permitted learners to participate in student-centered learning activities along with their classmates and other learners across the State of Florida from October 12 through November 6, 1998. Approximately 150 Florida teachers joined the expedition, participating in a variety of ways. Some classrooms completed the "Become an Archaeologist" sequence; others worked on the Expedition Challenge. Participants included teachers and learners from public school systems, private schools, home-bound students, and home-schooled students.

Many tasks involved a focus on cooperatively-determined problems and the solving of complex, real-world problems, that permitted an interaction with archaeology experts. Learners and teachers corresponded daily with the Expedition Team to receive approvals for class teams, equipment lists, and answers to the daily Mystery Artifact and Help Find It! (a Florida geography quiz). There were also four live broadcasts where learners were able to e-mail or call-in questions to historians and archaeologists. Archival records have been retained so that teachers can use the materials in their classrooms for years to come.

Conclusion

Web-based learning environments can be exciting experiences for both learners and teachers. Learners can help construct the learning environment to meet their individual learning needs and teachers can take advantage of pre-developed and emerging materials to enhance their curriculum. The development and implementation of virtual learning environments is a complex endeavor that requires a strong theoretical framework to permit effective development and implementation.

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A-MATE: A Multimedia Authoring System for Teaching ESL

Ryoji MATSUNO
Faculty of Administration, Prefectural University of Kumamoto, Japan
matsuno@pu-kumamoto.ac.jp

Yutaka TSUTSUMI
Business Administration and Information, Kyushu Teikyo Junior College, Japan
yutaka@kyu-teikyo.ac.jp

Kazuo USHIJIMA
Graduate School of Information Science and Electrical Engineering, Kyushu University, Japan
ushijima@csce.kyushu-u.ac.jp

Introduction

Multimedia technologies have made rapid progress in recent years. By using these technologies advantageously, we can create more powerful and effective educational teaching materials. However, developing multimedia teaching materials requires computer programming, which may be an insurmountable obstacle for ESL teachers who want to develop such materials, but are unfamiliar with computer programming. As a solution to this problem, we are developing a tool that helps a teacher create Web-based exercises and quizzes for their classes without requiring any programming. An ESL teacher will be able to create various types of exercises by preparing teaching materials, according to a simple format, without the need for any programming code. Our tool will be able to automatically create the appropriate HTML/JavaScript forms and pages by extracting necessary information from the prepared materials. The tool now under development is called A-MATE: A Multimedia Authoring System for Teaching ESL. We first began the A-MATE project in order to incorporate the option of creating individualized ESL teaching materials into our "Hypermedia Pronunciation Power Program," (Matsuno & Tsutsumi, 1998). "Pronunciation Power" helps ESL students improve their English pronunciation. However, we have found that A-MATE also has great potential as a stand-alone program, and would be useful to ESL teachers.

Strategy

The user interface of A-MATE should be as easy to use as possible, so that an ESL teacher can devote his or her main energies to developing teaching materials, rather than struggling through a computer program. After our analysis of TOEFL and TOEIC exercise texts, as well as ESL textbooks, we found several types of exercise patterns. Those patterns are: 1) Presenting pictures, 2) Presenting spoken dialogues, 3) Presenting sentences, or 4) Presenting (playing) videos, and then giving questions. Additionally, there are several question/answer patterns: A) Choose one answer from -n possible answers, B) Connect -n to -n items, C) Complete sentences, and D) Arrange -n mixed-up items into the proper order.

To sum up, we can abstract typical ESL exercise activities as follows:
1) Present example problems utilizing a (multi-)media type and format.
2) Choose one out of a group of question/answer patterns.

We have plotted our program strategy to produce student exercises based on above two ESL development activities adopted in general:
1) A teacher chooses one exercise pattern from the group of exercise types.
2) The teacher also chooses one question/answer pattern from the question/answer groups.
That is basically all that a teacher has to do. We will describe A-MATE in more detail in the following section.

Description of A-MATE

A teacher prepares his or her teaching materials in advance. The teacher may collect these materials via the Internet, or capture them from other media formats such as CD-ROM, Laser Disk, and/or VCR. As we mentioned above, A-MATE internally treats each type of exercise in a similar way. However, A-MATE offers several types of exercises for the teacher's convenience. Figure 1 shows the A-MATE Menu. In Figure 1, if a teacher clicks the "TOEFL" button, the menu for TOEFL exercises pops up. Then, the teacher can choose an exercise type from three options as follows: "Listening Comprehension," "Structure and Written Expression," or "Reading Comprehension." In Figure 1, if a teacher clicks the "Other Exercises" button, Figure 2 pops up.

If a teacher clicks the "Next" button after choosing menu items as in Figure 2, another card appears, and then the teacher is urged to input his or her specific questions, the number of possible multiple choice answers, and both the correct answers and the incorrect answers for each multiple choice question. We think the more the number of correct/wrong answer combinations grows, the more students can enjoy the variety of quizzes. This is due to the runtime randomization function of A-MATE. At runtime, A-MATE chooses one correct answer, and chooses n-1 wrong answers randomly from the group of wrong answers that a teacher has prepared in advance, and mixes up the correct answer with the wrong answers. This means students can try different patterns of quizzes, and A-MATE should automatically judge if students' answers are right or wrong. Table 1 shows how A-MATE's actions correspond with each exercise type at runtime:

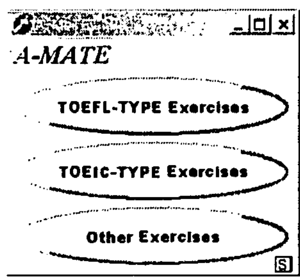

Figure 1: Main Menu

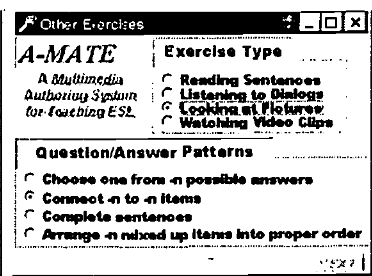

Figure 2: Sub Menu of "Other Exercises"

Table 1: A-MATE's Action

Type	*Required Inputs*	*A-MATE's Action at Runtime*
Choose one from -n possible answers	-n, one correct answer, and at least n-1 wrong answers	Choose one correct answer and n-1 wrong answers, and then mix them up
Connect -n to -n items	-n and at least -n pairs of items	Chooses -n pairs of items and mix them up
Complete sentences	Input sentences, and then mark words a teacher wants to hide	Hide marked words
Arrange –n mixed up items into proper order	-n sentences in proper order	Mix -n sentences at random

Discussion

There are several excellent authoring tools such as Macromedia Director and Asymetrix Toolbook. However, these packages demand a certain degree of programming knowledge and expertise, and can be difficult or time-consuming to effectively utilize. Nonetheless, such tools are quite useful for courseware design. If our goal were to make more complex courseware programs, with many additional options, A-MATE would not adequately serve the goal, and authoring tools such as those above-mentioned, would be preferable. However, with A-MATE, it is not necessary for the ESL teacher to acquire any knowledge of scripting, as the design parameters can cover most of the commonly used ESL exercise patterns, without any additional programming on the teacher's part. In the future, we also plan to develop software solutions for recording and calculating students' exercise results, and add methods for student grading optionally.

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The Educational Technology Professional Development Program

Michael Szabo, Ph.D., University of Alberta
Mohammed Aly, Ph. D., Northern Alberta Institute of Technology
William Fricker, Northern Alberta Institute of Technology
Richard Poon, Northern Alberta Institute of Technology
Clayton, Wright, Ph. D., Grant MacEwan Community College

Abstract: Postsecondary Institutions (PSI)s in Alberta, Canada are exploring ways to promote the development of educational technology for on-campus, multi-campus and distance delivery of instruction. It became apparent that professional development was the way to harness the intellectual capital of the instructors and to provide the critical mass to carry out the enormous task before them. A collaborative initiative was proposed to develop a common set of instructional materials on the topic of educational technology for professional development in all PSIs in Alberta. Phase I resulted in the production and validation of 25 print-based modules on key topics in educational technology. Faculty and staff from 13 of Alberta's 27 technical institutes, colleges, and universities participated in developing and validating one or more of these modules. Participants may obtain certificated credit from a university and/or continuing education credit from their home institutions. Phase II, scheduled for completion by the summer of 1999 will involve the transformation of the original 25 plus an additional 5 modules on leadership training to interactive, multimedia format suitable for delivery via the World Wide Web. In addition, one educational technology facilitator has been hired at each of the principle institutions to provide professional development opportunities for faculty and staff using the print-based modules at their respective institutions.

Overview

In 1997, the Department of Advanced Education and Manpower established a series of grants to post secondary institutions (PSE) in the Province of Alberta. The grants are designed to promote the use of instructional technology in order to increase achievement, learning efficiency and most of all access to a broader range of residents of Alberta. A secondary goal is to foster cooperation among the institutions in the Province.

For Phase I, the Northern Alberta Institute of Technology (NAIT) and Grant MacEwan Community College (GMCC) formed a consortium to create a series of 40 print-based modules for professional development of faculty and staff in the area of educational technology. The modules were produced and validated by faculty and staff from over a dozen institutions during the 1997-1998 academic year. Faculty may opt for certification from the Faculty of Extension of the University of Alberta.

Phase II begin during the summer of 1998 under the leadership of NAIT, GMCC and the University of Alberta (UA). The first of two goals is to enhance the print modules with interactivity and convert them to web-based instructional delivery (WBI) for increased access and to model WBI as part of the professional development of faculty. The second goal is to hire a trainer at each of the 3 lead institutions to train faculty in educational technology concepts using the print- and later web-based modules.

To date, the print modules are being heavily used and the trainers from each of the three institutions are actively conducting both large and small group training.

Development of the ETPD Print-Based Modules

The Province of Alberta has been on the leading edge of educational technology since the early 1960s when the UA acquired an IBM 1500 CAI System. The tradition has continued with subsequent applications at many other Alberta PSEs. The application of educational technology proceeded through many research and development initiatives from 1965 through to the late 1980s. At that time, recession and budget cuts reduced the availability of resources to continue on the cutting edge. In the middle 1990s, however, the government of Alberta began to return some funding from the major cuts of previous years in the form of targeted grants. These grants were aimed at development of educational technology systems which would increase access to all citizens of the Province, rather than just those who could physically attend one of the many campuses.

At the same time, the demographic trends began to be recognized; older adults who want basic and relevant skills, minimal career interruption, corporate training competencies, and concerns over non-traditional institutions beginning to take over training.

The Educational Technology Professional Development (ETPD) Project was established in recognition of the need for training of faculty and staff in the use of educational technology. Secondarily, it is recognized there is a need for faculty of institutions to come to grips with the issues of change and reform which, some argue, educational technology can provide (will bring?). To accomplish the training, the consortium identified the necessary content, format, and expertise within the Province to design, develop and validate the modules. The modules are organized into the four areas of Computer Literacy (9), Institution-Specific Topics (7), Educational Technology Core (9), and Specialization Areas (15).

Examples from Computer Literacy include Basic Keyboarding, Basic Word Processing, Image Scanning, Creating WWW Searches, Basic Spreadsheet and Database Management. From the Institution-Specific topics include Electronic and Voice mail, Knowledge of Printing and Support Services, and Network Familiarity. The Educational Technology Core includes such topics as Instructional Design, Survey of Educational Technology, Independent Study and distance Education, and Layout and Design for Print Materials. Specialization Areas include things such as Web Page Design, Advanced CD-ROM, Presentation Graphics, Audio-Teleconferencing, and Introduction to Computer-Assisted and -Managed Instruction.

The modules were created and validated by faculty members from ten different PSEs in Alberta and are available through GMCC. Interested faculty may arrange to complete a specific number of these modules in a program operated by the Faculty of Extension of the University of Alberta. Several of the PSEs are using selected modules as part of their graduate and undergraduate programs in Instructional Technology/Distance Education.

Development of the ETPD Web-Based Instruction Modules

Phase II recognizes the need to provide the modules in modern electronic format using the WWW. At the same time, using the WWW must include adding value to the modules in the form of interactivity, ease of access, and finally to provide a model of what WBI can do for the faculty users. Funding was obtained by NAIT, GMCC and UA to re-design and develop 30 of the modules into WBI format.

As of this writing, standards have been established and development of modules is underway. Issues such as who, how, where and what are being resolved. In addition issues of platform, servers and telecommunications links and speeds have been resolved.

In recognition of the fact that training is a necessary but insufficient condition to bring about change in the use of the innovative nature of educational technology, a series of 5 modules on dealing with the change process in the context of educational technology is being developed. These will complement and be a part of the 30 WWW modules. Example topics in this series include Dealing with Mental Models, Sharing a Vision (for Educational Technology-Driven Change) and Long Range (multi-year) Planning.

Also in Phase II, a full time trainer has been hired at each institution to provide group and individual support to faculty with respect to the use of educational technology. During this presentation, an update on the usage and WWW development (scheduled for completion for summer 1999) will be provided. In addition, sample modules will be made available for examination of structure, content and methodology.

For More Information on ETPD Modules and Training, contact

Clayton R. Wright, Ph.D.
Coordinator, Instructional Media and Design
Grant MacEwan Community College
Edmonton, Alberta, Canada
P.O. Box 1796
Edmonton, Alberta
Canada T5J 2P2
wrightc@ADMIN.GMCC.AB.CA

Multidisciplinary Development of Sophisticated E^3 Learning Models

Robert Hinks, Ph.D.
College of Engineering & Applied Sciences
Arizona State University - Main
Tempe, AZ 85287-5306, USA
robert.hinks@asu.edu

Introduction

Many people - including legislators and governing boards of educational systems, college and school administrators and faculty, owners of learning technology companies - are searching for a signpost that indicates the best way forward for education. Appreciating the fact that knowledge is being reorganized, none can say with certainty how education will be done ten years from now. One crucial question, the answer to which would provide an important clue as to what may lie ahead, is "what should be the role of modern computer and communication technologies in the future of education?"

Considering the fact that effective communication is at the heart of good teaching and learning, interactive multimedia CD's and resource-based learning using the Internet would appear to have a bright future in education. Moreover, advances in these and other technologies continue to change many aspects of modern life, often in very significant ways. Notwithstanding these facts, just how far new technologies will move us along the path towards more effective, enjoyable and efficient learning (**E^3 learning**) is an interesting question to contemplate. It is possible that the use of modern computer and communication technologies in education might not advance far beyond their current role as useful additions to traditional methods of teaching and learning. However, the same technologies *could* lead to the development of entirely new learning materials and learning environments that, if successful, would require a large-scale reassessment of the function of educational institutions.

The E^3 Learning Model

The answer to the question of where education goes from here might be another question: "what (technological) developments in the quest for E^3 learning will capture the interest of students?" Most current educational applications of computer and communication technologies do not demonstrate the full potential that they possess to improve learning. For an effective demonstration, it will be necessary to create a highly developed "whole product" - an *"integrated learning system"* - that includes *all* components of a course and facilitates the human interaction necessary to create a supportive environment for learning. Integration of new, comprehensive and sophisticated methods of communication into an optimal technology-driven learning environment is a prerequisite for the success of advanced technology-driven E^3 learning models at the post-elementary levels.

It is quite possible that the reaction of students to new learning systems will be the signpost that legislators, administrators and others pay most attention to. Appropriate technology-based systems providing complete, flexible learning experiences will attract students. When these systems also demonstrate the potential to be well integrated with other school or college activity then institutions will shake off uncertainty and nervousness and become enthusiastic about their future in a new learning environment.

The transformation of conceptual components of a new technology-driven model of learning into products that have worldwide appeal to students requires a clear objective and a sound plan to achieve it. The objective, broadly defined, is as stated above. That is, to create an integrated learning system by combining the latest computer and communication technologies with the desirable components of traditional education. If development of new computer-based learning products is the force driving this work, then the first requirement of the plan - an element that is crucial to the success of the entire endeavor - is to have the appropriate mix of people on the technology research and development team. Persons with a vision of what education could become, and possessing not only creative talent but also relevant (good or bad) experience of current education systems, these special people will possess vital components of the knowledge and dedication necessary to achieve the objective. The "appropriate mix" will draw from many disciplines, and include persons from traditional populations of the academic community as well as further afield. This is a very important point. Whereas many educational applications of technology have been developed by college faculty or specialists employed by learning product companies, sophisticated "whole products" will result from the combined efforts of people with diverse talents. Faculty, *students*, *alumni* and others having knowledge in the area of learning being redesigned, or with expertise in computer or communication technologies, or the learning sciences, communication arts, etc., etc., must work together to create the highly-developed products having potential to reinvigorate education at all levels.

To emphasize this point even further, some school and college faculty learn the elements of multimedia or other types of computer software in order to develop learning "modules" that illustrate parts of courses they teach. Faculty and students in media arts use the same software to develop creative works that typically communicate something quite different. When education technologists utilize the software they do so primarily from a learning sciences viewpoint. All of these talents must be combined - *at a higher level than ever before* - to create the new technology-driven E^3 learning methods!

The CoBaLT Team

In 1995 the author created an informal partnership of students, faculty and alumni of Arizona State University to explore the use of advanced multimedia software to develop computer-based learning modules for college-level engineering courses (Hinks & Lerman, 1996). Members of the partnership, named CoBaLT for *Computer-Based Learning and Training*, has ranged from 3 to 7 persons representing a number of academic disciplines, including computer science, engineering, chemistry, architecture, education, music and the media arts. The members have had extensive discussions on the shortcomings of traditional education and the best ways to improve learning. Our experience has underscored the importance of research and development taking place in an interdisciplinary setting, and "hands-on" experience has led to a high level of confidence in the use of advanced multimedia software. Several prototype multimedia modules have been developed and demonstrated. Perhaps most importantly, an appreciation of the opportunities and challenges offered by the new computer and communications technologies has been gained.

Findings

The CoBaLT team believes there are three aspects of E^3 learning model development that are critical to success, namely:

1. The project manager needs to pay constant attention to the interaction among all members of the model development team. This requires every participant, regardless of area of expertise, to fully understand and support the team's objective. Regularly scheduled, well-planned meetings are essential, and must include the full participation of all team members.
2. Another significant challenge is to establish a viable model of the multimedia design necessary for optimal E^3 learning. The goal here is to develop a clear and concise understanding of the entire multidimensional framework that replaces the traditional linear approach to the presentation of knowledge. High-level software, representing the latest in integrated media technology, has to assemble the knowledge contained in each module of the framework using a standard – but flexible – "skeleton", the components of which allow connections among the multiple formats of integrated media to be represented in the same way from module to module.
3. The third component of optimal model development is efficient utilization of computing hardware and identification and use of the most suitable multimedia software. Software for sound (including music), text, graphics (including animation) must be compatible. In our experience, it is advantageous if more than one team member is familiar with any given software.

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Interactivity: Strategies that Facilitate Instructor-Student Communication

Karen L. Rasmussen, Ph.D.
Professional Studies and Technology
University of West Florida
Pensacola, FL 32514
krasmuss@uwf.edu

Pamela T. Northrup, Ph.D.
Professional Studies and Technology
University of West Florida
Pensacola, FL 32514
pnorthru@uwf.edu

Introduction

Instruction through the World Wide Web is a viable alternative to the traditional, formal classroom environment. Students from kindergarten through post-graduate classes take advantage these opportunities to enhance their learning experiences. One of the criticisms directed toward WBI is that there is lack of interactivity and this lack of interactivity consequently reduces instructional effectiveness. There is a perception that students are isolated and that there is a lack of communication among instructor and students. However, using interactive instructional strategies can facilitate the development of intellectually motivated students.

The Fundamentals of Interactivity

Over the past two decades the term interactivity has been used in many contexts. Interactivity, in the 1980s, referred to the hardware required for Levels I-IV of interactive videodisc technology. In the past few years, researchers began examining the nature of the interaction rather than the capabilities of specific hardware. Schwier (1993) proposed a taxonomy of interaction that incorporates levels, functions, and transactions for a multimedia environment. The three levels of interaction proposed were reactive, proactive, and mutual. Reactive interaction is basically used for responding to given questions. Proactive interaction emphasizes generative activity and construction of new and meaningful knowledge. Mutual interaction is reserved for artificial intelligence and virtual reality environments.

Based on this earlier research in multimedia design, proactive interaction is of most interest in the design and implementation of interactive WBI. Self-awareness, self-regulation, problem-solving, and decision-making skills are most supported by a generative environment (Bruning, 1994). Instruction created for the web environment can be developed that is generative in scope and interactive in nature through a student's active involvement in the instructional process. Interaction and subsequent communication levels are facilitated through three different modes: (1) student-to-content; (2) student-to-student; and (3) student-to-instructor. Each mode is not mutually exclusive as a combination of interaction types actually strengthens the learning environment and promotes multiple instructional strategies for communities of diverse learners.

Designing Instruction for Interaction and Communication

Answers to the question, "what is the role of instruction," suggest prominent instructional strategies to facilitate modes of communication and interaction within web-based instruction. A sampling of activities and instructional strategies should be used to facilitate the different modes of interaction and levels of communication. For each mode and level, unique strategies can be developed within the context of the web-based learning environment. As web sites are developed to facilitate the instruction, appropriate design elements can be incorporated that assist students in the interaction and communication processes.

Student-to-Content Interaction Strategies

Instructional. One of the primary ways that students participating in WBI receive information is through interacting with the lesson content. Comprehensive electronic lectures may be used to present information. Organizing strategies, such as advance organizers, tables of contents, and lists help guide the student through the lesson. Students may also explore teacher-included web links for elaborated information or information from a various sources and opinions. Embedded questioning techniques can help to keep the learner on task and engaged in the learning activity. Questioning frames can also be used to direct students through searching, discovery, and exploration activities. Summaries of the lesson can refocus the student on important points and prepare them for supplemental activities that promote retention and transfer of information.

Web Page Designs. Strategies for interaction are important for student-content interaction; however, design of the web page is equally critical. Pages should be aesthetically pleasing and appropriate for the learning situation and should follow appropriate screen design/layout principles. For example, relevant graphics can be used as needed. The text can be formatted so to permit students to follow the lesson and to motivate them to continue working through it. Lines and lines of text should be avoided to prevent information overload. Instructions and directions need to be clearly stated and highlighted so that they are set apart from the instructional material. Likewise, web links should be distinctly noted and return instruction included.

Student-to-Student Interaction Strategies

Instructional. Student-student relationships are difficult to generate by the very nature of WBI itself. Students are never actually in the same room with each other and, consequently, traditional ways of building a cohort (e.g., personal communication, before, during, and after classes; in-person group activities) are not possible. Discussion and responses take place over extended periods of time, reducing spontaneity and conversation flow. Strategies such as early formation of groups, changing groups often, and mentoring among novice and expert students can be used to assist students in developing effective group techniques.

Web Page Designs. When building group discussions, activities such as chats, threaded discussions, e-mail, listservs are typically used to facilitate student-student interactions. Other technologies such as web boards and desktop video conferencing can be also used.

Student-to-Instructor Interaction Strategies

Instructional. The student-instructor interaction in WBI is potentially very personal and can be viewed as a mentor-student relationship. Through e-mail, personal communication is promoted; instructors can develop one-to-one relationships with their students that may not be possible in a traditional course.

Web Page Designs. As with suggested designs for student-student interaction, student-instructor design elements include consistent location of communication links and easily available help and frequently asked questions. Strategies that instructors may use to facilitate student-instructor interaction include: automatic response (sending receipt acknowledgements) and responding to all when asked a question by one.

Conclusion

There are many instructional strategies can be used to facilitate interaction in a web-based environment. Effective use of these strategies permits students and instructors to actively engage in the learning process and develop positive, meaningful relationships that build generative, interactive learning environments.

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Pedagogical Challenges for the World Wide Web

Tony Fetherston
School of Education
Edith Cowan University
Perth, Western Australia
t.fetherston@cowan.edu.au

Universities are showing increasing interest in raising the standard of teaching that occurs in their courses. There is a growing awareness that the traditional model of lecture/workshop/tutorial/assignment may not be the best approach in promoting learning in students. Concurrently with this change, there is increasing use of the World Wide Web(WWW) to deliver courses to internal and external students.
It is timely then to examine the role of the WWW in moves towards better teaching and learning for internal and external students at university.

Learning approaches

The first challenge is to begin regarding the use of the WWW not as a delivery medium but as teaching and learning tool. Once viewed this way we can allow pedagogical constructs to be applied to the use of the WWW rather than just examining the technical issues surrounding the use of the WWW.
The usual approach in most internal courses at universities involves a lecture/tutorial format in which material is delivered at lectures and discussed at tutorials. The unspoken assumption is that delivery of the material (lecture) results in learning of the material. This approach is called transmissive and assumes a strong link between the means of education and the ends. That is, having delivered the material then students are assumed to have learnt.
For external students, materials delivered by the web offer access to easily updated textual materials, some limited interactivity with programs on the WWW and access to audio and video that can be streamed in real time. This makes it technically possible for them to watch a lecture in real time without attending the university. This is also a transmissive mode of learning.
Approaches that encompass collaboration and build a sense of community would seem to be ideal for support by the use of the WWW and are becoming an important focus of research (McMahon, 1997; Dillenbourg & Schneider, 1995; Walker &Lambert, 1996).
If we start to regard the WWW as a teaching and learning tool that can support social constructivist approaches to learning, then University lecturers will need support as they undergo personal, social and professional change.

Joining the community

The WWW has probably been the main influence that has changed the way we conceive of computers. They are no longer machines which have to be conquered or commanded but have become transparent (though maybe some operating systems and browsers make them translucent!) windows into an information world. Students need a sense of this world, a sense of the audience participating and an understanding of the mostly unwritten rules that govern its behaviour in order to successfully use the new medium. The second challenge facing the use of WWW then is to equip our tertiary students with the conceptual models and practical skills to enable them to participate in this community. This is necessary because, according to a social constructivist view, participation can result in good learning. Once they can participate then we face the challenge of equipping our students with the critical thinking skills necessary so that they can confidently use information on the web for learning purposes..

Using the technical features for learning

Students can fill in forms, watch video, complete a multiple choice test, have it marked, watch live video, listen to live broadcasts, watch animations, submit written assignments, email other students, talk to other students and look at other students through the use of the WWW. These capabilities represent clever technical achievements and there is no reason to think that development in this area is likely to slow. However these achievements pose a third challenge (related to the first) of how to best implement technical capabilities so bring about meaningful learning. Which means finding good pedagogical practices that will build on the inherently engaging nature of the web and produce good learning.

Assessment

To answer this question would require a consideration of a broader range of assessment techniques currently used at universities in order to uncover differences in learning. Such consideration is likely also to occur if universities contemplate outcome-based approaches. Assessment should be reconsidered in most university courses with the advent of the use of the WWW and this presents a fourth challenge of how to best use the web for good assessment. Good assessment is valid and authentic and would mean practices like providing opportunity for assessing student's procedural skills, allowing students to critique set problem and allowing students to make up their own questions.

Learning to learn

The fifth challenge facing the use of the WWW in universities is to how best use the web to encourage good learning behaviours in students. As an example of the kind of behaviour to be encouraged, metacognition is universally regarded as an essential attribute of good learning. If students have good knowledge of the nature of their learning, of their effective learning strategies, of their learning strengths and weakness and can be given some control over their learning then better cognitive and affective outcomes will result. Further, conceptual change requires metacognition and metacognition helps recognition, evaluation and revision of personal views (Baird & Northfield, 1992). The WWW with its essentially individual approach to education has potential in this area to meet this challenge if appropriate design strategies are employed. If the design of courses allows individual exploration coupled with reflection and the comparison of views with others then metacognition can be enhanced and good learning can result.

Change

A final challenge to the use of the WWW is faced by lecturers themselves. Using the WWW means that lecturers will have to change their usual practice. Change to embrace the WWW and to meet the above challenges would probably be driven by a belief that learning in their courses is not as good as it could be and that assessment could be improved. It is likely that the use of the WWW for distance education students is likely to be restricted initially to its use as a delivery platform as good instructional design is required to meet the above challenges. It is far more likely that the challenges can be met through the use of the WWW to support the internal delivery of courses as lecturers can more easily implement a different approach. For this reason the WWW is likely to be used in good teaching and learning mostly in internal courses.

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Supporting Primary and Secondary Education Through a Centre for Distance Training

G. Papadopoulos, A. Gogoulou, E. Gouli, H. Houssou
Pedagogical Institute of Greece, Department of ICT
E-mail: {gpap, rgog, lilag, ehous}@pi-schools.gr

Introduction

The rapid evolution of science and technology causes changes in all aspects of every day life. It has become necessary for everybody to develop learning skills and have the opportunity for life long training in order to conform to the demands these changes impose. Especially for the teachers who play major role in the application of the educational system, mechanisms providing continual training and daily support need to be established. In our country, the teachers' training is facing a lot of difficulties due to the fact that there are a lot of distant and secluded regions and islands. The use of the information and communication technologies opened up new opportunities for accessing educational material and participation in distance courses, which can be better adapted to the trainee's needs, offering greater interactivity, providing more possibilities of individualisation of the learning process, in which the trainer is not a mere transmitter of knowledge and the trainee is not just a passive receiver. The Hellenic Pedagogical Institute has introduced a Distance Training Centre, called "Hellenic Distance Training Centre" (HDTC, http://hdtc.pi-schools.gr) which provides new ways for training and collaboration between scientists, teachers and students.

HDTC Services

In the context of making the teachers active members of a world-wide educational community and giving them the opportunity to find out the educational potential of the new technologies (ICT), the HDTC aims at the: a) provision of in-service, distance training; b) elimination of teachers' and schools' isolation; c) removal of barriers to learning, ensuring accessibility for the majority of teachers and students; d) provision of collaborative opportunities via the Web; e) development of added-value services utilising the existing technological infrastructure at schools; f) contribution to the formation of new attitudes towards the teachers' training and the exploitation of new technologies for the improvement of teaching and learning.

The implementation is Web based, incorporating all the necessary tools for interpersonal communication. The provided services are based on the following three scenarios i) *supported self-learning* ii) *collaborative learning* iii) *virtual classroom*. These services are structured as follows:

Training material: It is very important for teachers and students to learn about the role of ICT and its implications. The use of ICT has significant advantages both for the students who may gain a lot in information handling, motivation, problem solving, etc, and the teachers who have more opportunities for individual teaching and group work, for rethinking and applying new teaching and learning strategies, etc. This material concerns: a) *information and communication technology in learning*; b) *basic technical knowledge*; c) *scenarios - lesson plans for the use of ICT in the classroom*; d) *educational software*; e) *research projects*.

Curricula – textbooks: The teachers have the possibility to be informed in time for the new curricula and textbooks and contribute to their development by sending their comments and suggestions. They can also send relevant questions or ask for clarifications in order to be prepared before their application in schools.

Discussion fora: The discussion fora environment intents to promote and facilitate the exchange of information among teachers and contribute to the solution to common problems. The educational community, through this environment, has the opportunity to join several on-going discussions relevant to either specific curriculum subjects (e.g. Mathematics, History, Physics) or cross curriculum subjects (e.g students' assessment, use of ICT in education), raise issues to be discussed or answer to existing ones.

Educational web-sites and Conferences: A "guide-list" of Web sites is provided to the teachers and students which focuses on those Web sites that mainly offer lesson plans, additional educational material and collaborative activities. Also, bulletin boards for educational matters and conferences are presented.

Collaborative activities: Through several activities, the teachers are motivated to use ICT. These activities include evaluation of Web sites according to specific criteria, design of lesson plans, development of Web pages with educational material etc. The results of their work are presented via HDTC.

Help desk: This is a service of major importance, which aims at supporting effectively all the teachers to get over minor or major every day problems. It concerns the following: a) *tools and techniques*; b) *pedagogical issues*; c) *FAQs*; d) *submission of questions*; e) *mailing lists*; f) *bibliography search*; g) *comments- suggestions*.

Virtual classroom: The Training Centre has the necessary infrastructure to organise telecourses. It is responsible for the choice of the subjects, taking into account the teachers' preferences and needs. A group of experts from the academic community may be invited to engage in the telecourse. The communication is bidirectional, so that questions can be raised, clarifications can be given and collaborative activities can take place. The careful choice of the subjects, the trainers, and the effective management of organisational issues can result to active trainees' participation and the overall success of the telecourse series.

Conclusions – Future plans

The first conclusions, as these are drawn from the comments sent by e-mail as well as from the questionnaires that were completed by teachers are very positive and encouraging and point to the overall usefulness of such a centre. Unfortunately, in our country, it seems that the ISDN technology is still immature to be widely used at schools - the ISDN connection cost is high and the technical support is inadequate. Pedagogical Institute's forthcoming plans are focused on the following:

- the qualitative improvement and the renewal of equipment and services in the light of technological advances. More specifically we will work on a) the enrichment of the educational material b) the minimisation of the response time to the users' requirements, questions c) the best fulfilment of the teachers' needs and d) the promotion of public awareness and discussion about the HDTC and its benefits.
- the development of a reliable model for organising telecourses.

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STUDENT PERCEPTIONS: INFUSING TECHNOLOGY INTO TEACHER EDUCATION THROUGH ELECTRONIC PORTFOLIOS

Carla Piper, School of Education, Chapman University, USA, piper@chapman.edu

Dr. Susan Eskridge, Benerd School of Education, University of the Pacific, USA, seskridge@uop.edu

Preparing teachers for the 21st Century has been a concern for educational leaders in this country during the last two decades. The National Council for Accreditation of Teacher Education (NCATE) issued a report called "Technology and the New Professional Teacher: Preparing for the 21st Century Classroom" in 1997. The NCATE technology task force suggests that perhaps the best way teacher education faculty can inspire future teachers to use technology is "to cast themselves as learners and to experiment fearlessly in the applications of technology," making themselves "role models of lifelong learning" (p. 9). The task force states that re-educating the existing teaching force requires extensive professional development, but that the problem will be compounded if future teachers are inadequately prepared to use new technology (p. 7). NCATE has challenged higher education to incorporate technology across the entire teacher education program, not just as a "computer literacy" class added to the existing curriculum (p.7). The task force states that "today's teacher candidates will teach tomorrow as they are taught today" (p.4). NCATE states that teacher education is in a time of transition, calling for experimentation and a new attitude that is "fearless in the use of technology" (p.6).

The U.S. Department of Education states that technology offers "numerous possibilities for integrating assessment into the daily life of the classroom" (1997, April, p. 6). Portfolios have been helpful, not only in assessing student performance in teacher training courses, but in helping students reflect upon and organize the material learned in the courses. Developing portfolios electronically provides students with new ways to demonstrate a broad range of abilities, as well as give them greater awareness of the unique capabilities of technology in creating meaningful forms of alternative assessment. A well-designed electronic portfolio system can support this approach and offer expanded potential for collecting different kinds of records of students' work. Final products in a variety of media (text, graphics, video, multimedia), students' oral presentations or explanations, interviews that capture students' development and justifications for their work, and in-progress traces of thinking and problem solving processes can now be included using video and computer technologies.

This study focuses on the use of technology as a tool for portfolio assessment of teacher candidates as evidence of achieving course objectives. Students from a small California university created multimedia portfolios as a final assessment for a reading methods course. Course objectives were linked to state teaching standards, as well as the Reading Instruction Competence Assessment (RICA) goals. Initial attempts to use an HTML web format caused problems due to the students' lack of computer experience and expertise. Templates were pre-designed using Hyperstudio in order to provide a more workable framework for inexperienced students. A separate stack was created for each course objective and a menu stack provided space for personal artifacts and a philosophy statement. Each objective stack included a cover sheet text box for self-reflection and self-assessment. Artifacts were evaluated in terms of meeting course criteria and cover sheets were examined for evidence of student self-reflection and self-assessment. Students were interviewed to gain insight into the experience of collecting and preserving artifacts electronically.

Generally, the students responded positively to the electronic portfolio experience despite the initial concern over the technological expectations. Several students expressed frustration at having to work with computer technology in a reading methodology course. One student stated: "I was scared of the whole assignment at first because I didn't know how to use any other programs than word processing basically." Another student described her change of attitude toward the electronic portfolio process as she progressed through the semester:

> I was really negative about it at first because it was technology and I didn't know how...I didn't see how it really related to the English and Language Arts class and I didn't want to do it, because I

didn't see how it related to that. But, after I did it, I saw the relation and how it correlated. Actually I'm glad that I did it.

Students generally responded favorably to the use of templates. One student said: "I liked having the prepared one (template). That was great, 'cause I was getting started." Another student said: "The first one (disk) that we had was of the templates, which were good. I really liked the templates. Those were helpful..." Some students indicated an interest in developing their own design in the future. One student stated: "I liked having the template. I could change things later to spice it up." Another student described how she would improve her process in the future: "I would use Hyperstudio but I'd design my own template. The ease of the template took the stress off for the first time, but I'd do my own next time."

When students were asked what they saw as the purpose of the electronic portfolio project, one student replied: "I saw it as primarily a reflectionary tool. It was helpful to know you were gaining what you should get out of the course. It fulfilled various purposes, but I used it more for reflection on goals. It could also be a tool for interviews." Another student stated: "One of the purposes was to get me used to a new computer program, because I know that's one of the big things that we need to start getting used to now is all the technology. The other purpose was to show that I had met the necessary objectives for the class and that I understood that I met the objectives."

Students generally indicated a positive response to the use of portfolios for assessment. According to some students, electronic portfolios offered a more creative means of demonstrating evidence of meeting objectives.

> As with any portfolio, I was in the position to review all my work and the initial objectives of the course. In doing this I was able to assess my work and reflect upon how the work I completed met these objectives just by being able to tell you what I did for all these objectives or what stuff I put in there. I think I got more out of it than if I would have if I'd had to study for a test and just basically memorize and cram into my brain a bunch of stuff for just a couple of days, and then just spill it out on a piece of paper.

Evidence of self-reflection and self-assessment was present in all portfolios examined. One student stated: "The class really helped me feel prepared, but I think sticking it all in one place and making connections between the objectives and the things helped me say, oh look, I am prepared. Not only do I think I am, but I can tell you why." Another student explained the electronic process:

> As with any portfolio development, you are critically examining your work to determine which way you have met the selected criteria, and how you can best example or highlight your work. The process of developing the portfolio is a constant self-assessment. However, I don't feel that the electronic portfolio was more of an assessment than a hard-copy portfolio would be. The process is the same, it is the final output that is different.

NCATE states that teachers need new understandings about how technology has changed society as a whole and new approaches to using a wide range of tools and software as a part of their own "instructional repertoire" (p. 6). In the year 2000, NCATE expects to present new accreditation standards that make effective use of technology a central requirement for teacher preparation. Infusing technology into teacher training presents a challenge to educational institutions due to the ever-expanding accreditation requirements and time limitations. Student perceptions provide greater insight into the strengths and weaknesses of the electronic portfolio as a tool for assessment and as a viable means of integrating technology into teacher training.

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A Hypermultimedia and Multitechnology Networked Laboratory for Advanced Education

Enrico Nicolo'
Fondazione Ugo Bordoni, Research Division for Telecommunications Evolution, Roma, Italy, nic@fub.it

Bartolomeo Sapio
Fondazione Ugo Bordoni, Research Division for Telecommunications Evolution, Roma, Italy, bsapio@fub.it

New communications and strategic planning

Communication is a fundamental concept in educational practice. The attitude of professional educators and students towards distance education is influenced directly by the quality of the communication methods available [Price 1995]. The technological developments in the television, computing and communication industries are having a major impact on all aspects of life. The convergence of these technologies is bringing about new business opportunities, new home entertainment possibilities, new learning opportunities in traditional classroom teaching, self learning and distance learning. Developments in personal computer and interactive video techniques make it increasingly possible to demonstrate, experiment, analyse and simulate complex processes on screen. The World Wide Web, for example, provides new opportunities for quality distance education over the Internet. The Web, combined with other technological advances such as digital video compression, video systems, multimedia networking, voice activated computers, virtual reality, etc will offer a wide range of high quality on-line distant learning opportunities [Underwood & Underwood 1994].

Many research activities have been carried out over the years in the area of *strategic planning* and *scenario methodologies* (see for example [Georgantzas & Acar 1995]) but no great efforts have been devoted to facilitating their fruition by advanced learners. Enormous attention has been paid over the time to theoretical aspects of formal strategic planning but the gap between analytical details of the ensuing findings in various application fields and the necessity of easy-to-learn knowledge has not been adequately bridged. Therefore, methodological and technical efforts have to be made in order to make these disciplines easier to be learned during advanced education courses. These attempts can be made even by exploiting the tools offered today by technology, in particular by the "networked hypermultimedia" epoch which we are entering, characterized by the evolving global digital superhighway infrastructure and dominated by the huge planetary diffusion of the networked hypermedia World Wide Web.

In this context, *scenario engineering* includes a general corpus of scenario methods and techniques for strategic planning and pre-planning. Scenario engineering can be regarded as a pragmatic approach arisen in the area of scenario methodologies which has been conceived and developed for the construction of scenarios to be produced even by exploiting multisectorial technology resources.

NET-SIMULAB for advanced education

NET-SIMULAB [Nicolo' & Sapio 1998a, 1998b] is an advanced work environment suitably arranged to carry out research activities in the field of scenario engineering and to handle multimedia information in an interactive way. As regards the hardware configuration of NET-SIMULAB (Figure 1), there are three main workstations. Workstation 1 and workstation 2 are basically used for scenario generation and analysis. Workstation 3 is used for scenario presentation and documentation. A portable workstation is used for remote elaboration and can be connected to fixed workstations. Additional hardware includes external mass-memory units, hi-fi devices, video equipment and digital photographic facilities.

In particular, *scenario transfer* [Nicolo' & Sapio 1998c], a subset of scenario engineering specifically devoted to make scenario studies easy to use, can be oriented to education objectives. To this purpose, the instructional pattern for learners may include advanced navigation hypermedia tools and allow distance learning over the global network. Thus, NET-SIMULAB based scenario-engineering training management can be performed. As an example, instructional projects concerned with scenario transfer methodology could be addressed to scenario modellers, decision makers as well as scholars and students in the field of strategic planning. In this context, NET-SIMULAB is intended to serve as a knowledge and expertise centre oriented to "produce" scientific methodology for scenario transfer. This task can be significantly facilitated and strengthened by the access of NET-SIMULAB to the Web.

The success of advanced education in strategic planning greatly depends on the effective transfer of information about application hypotheses and methodological outlines as well as about results and findings to learners. Clear (intrinsically), comprehensible (for non-specialists), concise and correct (as to formal aspects) information can assure immediate and time-saving catching of key aspects by learners. We can call this important requirement the "four 'C's rule" (due to the initial letters of the words clear, comprehensible, concise and correct) and we consider it as a basic principle of an efficient and effective scenario transfer.

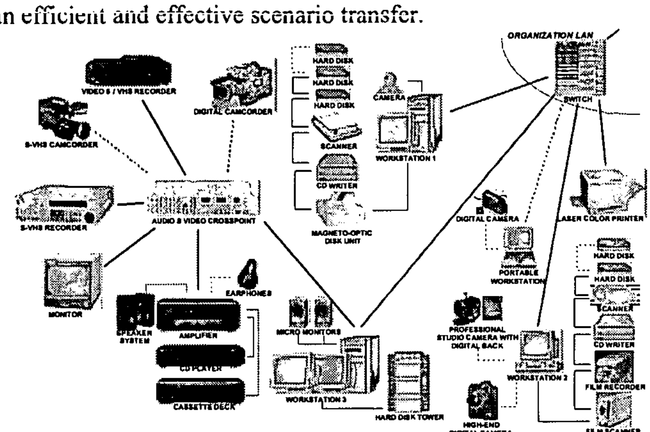

Figure 1: Technical configuration of SIMULAB

In this context, multimedia technology can provide powerful capabilities that should be suitably employed. Exploitation of sound and images (still images and full motion pictures) can significantly contribute to delivering easily understood, synoptical studies and therefore to facilitating their utilization. Furthermore, scenario documentation, presentation and communication are more effective if they are research-engineers—driven (i.e. modellers-, analysts-, simulationists-, methodologists-driven) through the use of multimedia facilities. As a matter of fact, such capabilities provide modellers with flexible technological tools which are suitable to calibrate and modulate the complexity level of the transfer contents according to the circumstances and the category of learners.

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Educational Assistance for Usual Classes Using Computer Network

Akira Watanabe
Faculty of Informatics, Meisei University, Japan, akira@ei.meisei-u.ac.jp

Michirou Yabuki
Faculty of Informatics, Meisei University, Japan, yabuki@ei.meisei-u.ac.jp

Hideyuki Nagaoka
Information Science Research Center, Meisei University, Japan, hide@cc.meisei-u.ac.jp

Introduction

In many educational organizations, networks are used for educational support. On the other hand, there are many traditional classes that have no educational support using computer networks. When one intends to utilize computer networks or the Internet for traditional classes, he will suffer from problems such as time for investigating teaching materials, manpower, arrangements of equipment and preparation of presentation data. In this paper, taking above points into consideration, we propose a method of introducing educational support using computer networks for traditional classes.

The method of educational support for traditional classes using computer networks

We set following goals for the proposed method. First, the purpose of the method is review and self-studying. Second goal is that the method could preserve the various teaching style of teachers. Third goal is that the method should be simple so that the number of staffs and a budget should not be large. Fourth goal is that the method is able to be adopted to traditional lectures and computer exercises. Last goal is that more than one simultaneous classes should be supported using the method. To satisfy these goals, we adopt the following means:

- *The scene of a class is recorded on video tape as it is. Afterwards the video is opened to the students through networks.*
  In this way, teachers do not have to make additional preparations for classes. Watching the video is enough for students to relive the class.
- *A written material or a computer screen of the teacher operates is also recorded on another video tape. This video and a teacher's video are synthesized to a single image for publication.*
  In this method, as the written material is created during the traditional class, teachers need not prepare anything than the usual lecture and need not change their teaching style.
- *The camera for recording teacher's movements has fixed view and never follows of teacher's movements.*
  Written material is more important than the teacher's movements. Especially for reviewing and self-studying, precise movements of the teacher are not necessary. Only the feeling of actually being in the class and the motion that the teacher points to something are necessary.

Implementation

There are following three steps to implement our proposed method. First step is to record the class. In the case of a class in which the teacher uses a blackboard, he must use a visual presenter instead of a blackboard. The output from the visual presenter is recorded and presented to students using a projection device. Another video camera records movements of the teacher from the rear side of the classroom. The view of the camera is fixed and it is left during the class as it is. In a case of a computer exercise class, we use a scan converter to record a screen of a teacher's computer. Another video camera records a keyboard and a mouse that the teacher operates. Second step is to make digital video data. Video of the teacher and video from the visual presenter are captured into a computer and merged into a single video. For image compression, we use the MPEG-1 format. Figure 1 shows an example of an MPEG video picture. Voice data is compressed in MPEG Layer II form. Third step is making digital video data public to students. We use the WWW as user interface for viewing MPEG-1 video. The WWW page contains names, syllabuses, titles and hyperlinks to MPEG-1 video for each class.

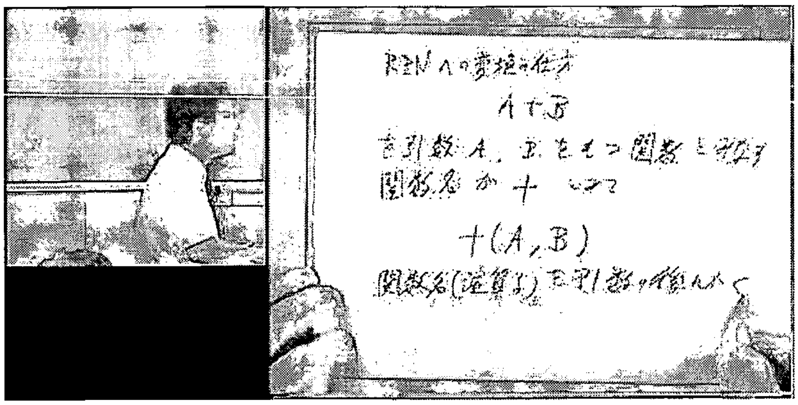

Figure 1: An example of an MPEG video picture.

Results

As experiments, we applied our proposed method to following two subjects in 1998. The number of supporting staffs was only two.

- "Exercise for information processing" course. This subject teaches a computer literacy for freshman students in the Japanese culture course. Each student uses a computer in the course. We applied our method to this course from April 17 to Jun 26 1998 (10 classes). The number of access times to the videos was 84 until July 1 1998. This number is fairly large because the number of absentee of each class was less than 10.
- "Computer literacy" course. This subject aims to introduce the computer science to freshman students in the information science course. Explanation of this subject was mainly carried out by speaking and writing. We applied our method to this course from Jun 9 to Jun 23 1998 (three classes). The number of access times to the videos was 134 until July 1 1998.

In both courses, teachers commented that this method was effective as an educational method for students who were absent from a class or students who had not understood well. Students who actually watched the video commented that this service was good because the points, which were difficult to understand during the class, were able to be reviewed. They also commented that self-studying watching the video was necessary since one might be absent from class because of compelling reasons.

Acknowledgement

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Improving Classroom Teaching with Computerized Presentational Tools

Alice Li
Department of Nursing and Health Sciences
The Hong Kong Polytechnic University
Hong Kong SAR, China
hsali@polyu.edu.hk

Gina C.W. Leung
Department of Nursing and Health Sciences
The Hong Kong Polytechnic University
Hong Kong SAR, China
hsgleung@polyu.edu.hk

Paul M.B. Yung
Department of Nursing and Health Sciences
The Hong Kong Polytechnic University
Hong Kong SAR, China
hspyung@polyu.edu.hk

Introduction

In Hong Kong there has been positive support, from educationalists, academia, and universities, for the integration of computer-based pedagogy in classroom teaching and learning (Li et al 1998). This study is in an attempt to support those initiatives by investigating the effective uses of computerized presentational tools (CPT) for enhancing teaching and learning. The central focus was to explore the potential benefits and usage the CPT for classroom teaching and learning and its contribution to the preparation of teaching materials.

There were two-fold objectives of this study. They are: 1) to gain feedback on classroom teaching and learning through the use of a CPT from the perspective of both students and teaching staff; and 2) to explore the possibility of using CPT as a standard tools for the preparation of teaching materials at the university. Triangulation methodology was used with combination of semi-structured questionnaire survey and in-depth qualitative interviews. The results are then used as the reference to enhance the teaching and learning through the use of educational technology.

In focusing on the effects of classroom learning, the components of the assessment were divided into six aspects. They are: the organization and structure of teaching material; clarity and legibility; visual stimulation; vertical interaction; efficiency in delivery of information material; learning environment and atmosphere. A sample of 300 students ranging from Diploma to Master Degree level in the field of nursing and health sciences was studied through questionnaire survey together with in-depth interviews on 30 students.

In exploring the experiences using CPT for improving classroom teaching and its potential to become a major foundation tools for developing teaching materials, the lecturers representing 3 different health disciplines (i.e. nursing science, biomedical science and behavioral science) who involved into this study were recruited for an in-depth interviews.

Conceptual framework

This framework was comprised with the components indicating the flows of knowledge transformation through classroom teaching and learning as shown in the following Fig. 1.

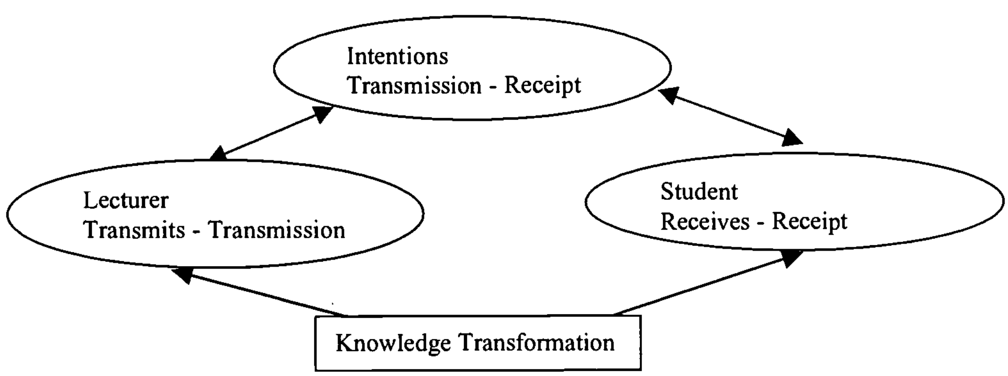

Fig. 1: Flow of knowledge transformation through classroom teaching & learning

Part of knowledge transformation can only be achieved through the process of teaching and learning within which the intentions is believed as one of the major factor to affect those outcomes. However, these intentions could be enhanced through the six dimensions of domains as mentioned previously (i.e. organization & structure of teaching material; clarity & legibility; visual stimulation; vertical interaction; efficiency in delivery of information; enhancement of learning environment and atmosphere).

Procedures

All students from 7 different classes ranging from Diploma to Master Degree level received CPT instructed classroom teaching. The contents of those teaching material were made by their subject lecturers and accordingly to their subject areas and academic levels. Questionnaires were given to each of these classes immediately after lecture. Feedback was received from 300 students. In addition, in-depth interviews were conducted with 30 students regarding to their opinion on the uses of CPT for classroom learning and teaching. The lecturers involved in using CPT instructed material for teaching were interviewed.

Findings

Apart from the descriptive statistics, the combinations of the statistical methods was used for the quantitative data analysis by using SPSS while NUD.IST package was used for the qualitative data analysis.

The results indicated that the computerised presentational packages for classroom teaching were well received by the students as effective tools to enhance the process of learning. The study also indicated some problems in enhancing a vertical interaction between the lecturer and the students, and feasibility of performing a computerised presentational package classroom teaching. The score comparison for the six domains on an overall reaction to a CPT instructed learning were shown in Fig. 2.

Interviews with lecturers reflected that they felt the CPT instructed classroom teaching would contribute to the process of teaching as well as the students' learning. They found the combination of different text fonts and colours display, which makes for the production of high quality teaching material in the textual format as well as integrating other formats such as pictures, graphics, sound and video. The flexibility in arranging the sequence of the presentation allows the lecturers to have a better organisation of the teaching materials and also serves as an information bank for learning materials.

In summary, they felt that CPT allowed better organisation of teaching materials in logical sequences combined with speedy display of the teaching contents to enable a smooth delivery of lectures. That also helped the lecturer to keep the time at their required pace. Consistency of similar lecture contexts for different classes can be maintained through this standardisation in the format of teaching materials being presented. It also facilitates the future development of modular or credit based system in our university.

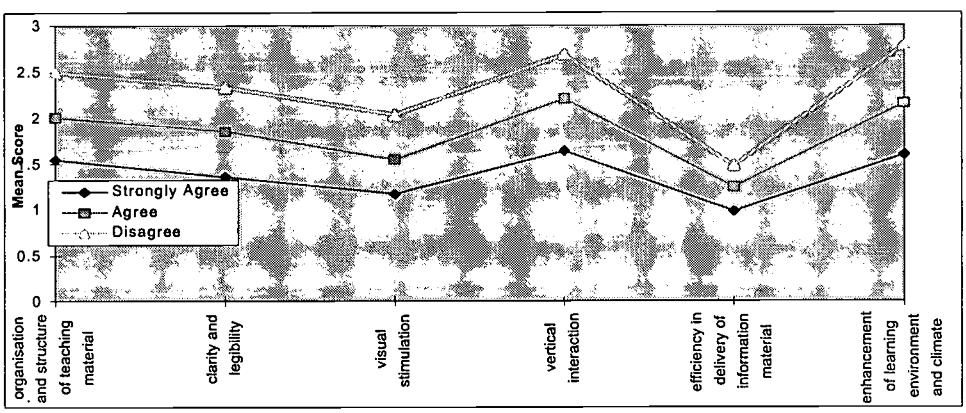

Fig. 2: Score comparison for the six domains on an overall reaction to CPT instructed learning.

There were some situational constraints imposed on the CPT instructed teaching. The lecturers expressed that the physical environment of the classroom, such as the size of the classroom, lighting arrangement and its intensity, will directly affect the quality of the display or projection. The technical set up of that equipment was also relatively time consuming. In addition, they pointed out that the operation of CPT instructed teaching required practical computer skills in order to ensure the smooth running of the lecture. In operating such educational technology, many lecturers are still green in experience.

In conclusion, the indicated factors influencing the perceived effectiveness of CPT instructed classroom teaching from the students and lecturers may serve as indicators for the future improvements of teaching strategies. We are optimistic that additional resources and support from the university can make computerised presentation teaching valuable for students and teachers.

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DESIGN AND EVALUATION OF A DISTANCE LEARNING COURSE ON THE WWW

Ana Amélia Amorim Carvalho
Institute of Education and Psychology
University of Minho
Portugal
E-mail: aac@iep.uminho.pt

The World Wide Web has been largely used on distance learning, but some problems arise, mainly related to students' feelings of loneliness [Schrum, 1997]. We decide to focus on this problem and also applying Cognitive Flexibility Theory principles to a 19th century Portuguese novel "Cousin Basilio" [Carvalho & Dias, 1997a] available at the following URL: http://www.iep.uminho.pt/primobasilio

On this research we focus on learners' feelings and opinions about the web course structure, and communication between learners. We also attend to subjects' attitude towards the computer and to their knowledge as users, and also to their "Learning Preferences" based on a scale that we developed [Carvalho, 1998a & 1998b]. Finally, we describe their opinion about being enrolled in other courses on the web.

"Cousin Basilio" Design

During the design of this document we had two main concerns: first of all to apply Cognitive Flexibility Theory principles to the novel "Cousin Basilio" from Eça de Queirós and secondly to recreate the 19th century ambience on the interface. If you access to the URL mentioned previously you will see an ancient book and on its cover you read "*O Primo Basilio*: múltiplas travessias temáticas" ("*Cousin Basilio*: multiple thematic criss-crossings"). Then you have some information - a Help function "Ajuda" - about the function of each button and the functionality of each path as soon as you press them.

Each page has some objects (buttons) available that recreate a 19th century atmosphere. All information and instructions to the user appear in blue, using a well designed handwriting. It has two menus: the main menu is on the left side top corner, and looks like an ancient street plate; the complementary menu is under the main menu. The information available on this second menu is dependent of the path chosen on the main menu, nevertheless it gives access to "Themes" (a general description of each of the nine themes selected for analysing the novel) and to the "Bibliography" (authors mentioned on "thematic commentaries" or on the description of the general Themes). At the end of the page there is a black pen that, when pressed, allows the learner to write his/her own notes. On the bottom, near the pen, there are three coins that when pressed give access to the content material and, later on, allow the user to quit the document properly. When this button (coins) is pressed in order to quit the document, some possible links related to the novel and to the author appear. The texts of the novel have a light yellow background that imitates old stationery. All comments that help to understand the texts appear on a blue background (this resembles an ancient official Portuguese stationery) that is sealed.

The main menu is always available and shows all the possible paths to the learner. The first path named "Casos" (Cases) presents five sequences of the book, each sequence containing several small texts (mini-cases) of the novel. According to Spiro and Jehng (1990: 181) "the mini-case (a segment drawn from a larger case) is the starting point for all instruction". Advanced knowledge acquisition has significant context dependent variations, so it is important to analyse several mini-cases according to multiple representations. The second path "Tópicos de Reflexão" (Topics for Reflection) has five topics. For the study of each Topic, several relevant mini-cases and thematic commentaries have been selected. "The notion of 'criss-crossing' from case to case in many thematic dimensions serving as routes of traversal, is central to our theory" [Spiro et al., 1987: 187]. The third path "Travessias Temáticas" (Thematic Criss-Crossings) allows the user to do a personal search, choosing the themes and cases. The last option is "Tabela de Conteúdos" (Table of Contents) with all cases and respective mini-cases and the indication of the applied themes for each mini-case.

Distance learning course procedures

This distance learning course on the web sets a pre-requisite on the subjects' background: they have to be undergraduate students or teachers of Portuguese literature.

This course integrates three packages to be sent to each subject with several instruments like Questionnaires (a Questionnaire about subjects' computer literacy and a Questionnaire of Opinion about the web document), tests, a "Learning Preferences" scale (containing the following dimensions: 'complex knowledge acquisition', 'autonomy in learning', and 'preference for complex knowledge'[1] [Carvalho, 1998a & 1998b]), guidelines for the session, participants' e-mail addresses, and

[1] The "Learning Preferences" scale has three dimensions: F1: alpha=0.83; F2: alpha=0.73; F3: alpha=0.63; the scale has a Cronbach's alpha =0.81 (Carvalho, 1998a &1998b).

researcher's contact. Exchange e-mail is not compulsory, but recommended if they like to share some ideas or some doubts. At the end of this distance learning web course, we ask the subjects to write a report commenting on several aspects like the document design, the structure of the course and their opinion about courses on the web for lifelong learning.

When they finished to answer all instruments on package 1, they had one session on a computer laboratory at the university with the purpose of making them feel comfortable to use and explore the document on the Web. At the end of this session, they received the second package. After having read all the descriptions on the general themes, and done the first path on "Cases" and the first path on "Topics", the users were challenged to try to build their own knowledge that they could check on the document. This kind of challenge has been successful in another study (Carvalho & Dias, 1997b). Each subject worked at his own pace. They were applying the packages according to their pace of learning.

Sample characterisation

We had nineteen subjects, 1 male and eighteen females, 3rd year undergraduate students enrolled in Portuguese Literature, ranging from twenty to twenty-nine years (the mean was 22.5 years and the mode was 20 years). We realised, when analysing the Questionnaire of Computer Literacy, that 2 subjects never used a computer, all the others were using it, but not often. Most of them had never explored an interactive environment, only 6 subjects had (31.5%) explored the Internet. We analysed their attitude towards the computer according to two parameters: attitude and feelings. The correlation obtained in these two parameters is high (.71). Most of them, thirteen subjects, liked to work with a computer, four subjects didn't like and two avoided it. Most subjects (15) felt comfortable when working with a computer, eleven of them liked to work with it, but four did not. Only two subjects felt "a little bit nervous" when they needed to use a computer. Finally, two subjects felt nervous and avoided to use a computer, but anyway they accepted to participate in this research. The results on the "Learning Preferences" scale pointed out a positive attitude[2] in all three dimensions.

Results and Conclusion

Although subjects' computer literacy was low, they felt it was easy to use the web document and to navigate on it. In addition, not only their opinion about the web document as a whole was favourable, but also in what concerns its structure, interface, orientation and its content.

All of them accepted positively the suggestion of having access to documents like "Cousin Basilio" on the web, as a support to their learning modules in the university and for further education. Some of the subjects that accepted the challenge of constructing the possible explanations of the applied themes to each text in the path "Cases" and to select the texts that support a given "Topic", said that "it helps to a deeper study", another one mentioned that she "realised that, when trying to explain thematic commentaries, some of her ideas were wrong, but others only need to be completed". Learning by doing (constructing) takes a great effort and strong involvement that are rewarded in the learning achieved.

All orientations and tasks to be achieved have been considered clearly enough. Most of the subjects used the university computer laboratories. Some went to the lab with a peer (12 subjects), others alone, but usually they met someone there with whom they shared some ideas. Only four subjects never shared ideas with others in the lab or after the sessions. They did not use the e-mail facility because they knew each other and they met regularly at the university.

We think that it is important for learners to have a face-to-face meeting with the teacher responsible for the course. In this way, they have the opportunity to see each other and to know the people to whom they are going to send a message, to clarify any doubt they have about the course, besides the introduction to the web document functionality. With this methodology, even those subjects that never used a computer or that seldom used it have the opportunity to learn to use it properly. The participants must be comfortable with the system and the software, so that they may concentrate on the academic tasks.

Finally, we think that if we want to have a real Information Society our undergraduate students have to explore the web for their study. The USA President's Advisory Panel recommend that "teacher education should focus on learning with technology while emphasising content and pedagogy" (Davis, 1997: 221). Today's undergraduate students are the teachers of tomorrow and they will know how to use the web with their students, if they are used to explore it.

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[2] The attitude is positive if •3.5 and •5, the attitude is indefinite if •2.5 and •3.5, and the attitude is negative if •1 and •2.5 [Carvalho, 1998a & 1998b].

A Web-Based Multimedia Instructional System for Language Learning

Miwha Lee
Pusan National University of Education, Korea
E-mail: mlee@ns.pusan-e.ac.kr

Aesun Yoon
Pusan National University, Korea
E-mail: asyoon@hyowon.cc.pusan.ac.kr

Introduction

A great amount of information is conveyed, during the communication, by means of verbal and non-verbal elements. The relationship of these various components is so pertinent and consistent that we might fail to converse if we cannot understand those non-verbal elements or use them appropriately (e.g., Bateson et al., 1981). Multimedia-based materials have a great potential to present both verbal and non-verbal elements and to combine them efficiently for language education. Moreover, the Internet has been increasingly utilized as an effective instructional tool for language learning, since the Web can become a multimedia-based content provider with versatility and interconnectedness (Harasim et al., 1996; Khan, 1997; McManus, 1995; Owston, 1997; Ritchie & Hoffman, 1996). The purpose of the present study was to design and develop a Web-based multimedia instructional system for French language learning. The instructional system was designed to encourage students to actively participate in the learning process by providing students with a learning environment that is flexible, individualized, interactive, and efficient.

The Content Structure

The content structure of the instructional system was designed to be adaptive to individual learning situations on a non-real time basis. Students can navigate the hyperlinked multimedia contents without a pre-ordered learning schedule. Through their exploration and navigation, thus, students can design their own instruction. The contents are divided into two levels: beginning and intermediate. Each level consists of 15 lessons developed to be easily integrated into the school curriculum in Korea. As shown in Figure 1, each lesson is composed of eight components: listening, reading, speaking, grammar, drills, games, pronunciation, and reading comprehension.

The Interaction facilities

The interaction facilities of the instructional system consist of four components: help, bulletin board, announcements, and e-mail. These interaction facilities were designed to provide various types of asynchronous communications among three different user groups: teachers or tutors, students, and system administrators (Boverie et al., 1998; Laney, 1996; MacKnight, 1998; Repman & Logan, 1996).

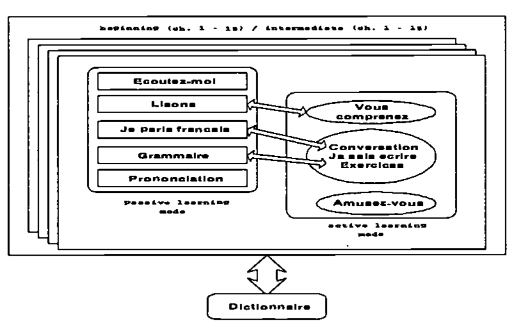

Figure 1: The Content Structure

The User Interface

In designing and developing the user interface of the instructional system, a special emphasis was placed on user-friendliness and efficiency. The user interfaces are differentially provided to each of the user groups, depending on their authorization status, since the user groups need different modes of interaction. For the consistent and systematic delivery of information, the subsequent hyperlinked information is presented in the same page. As shown in Figure 2, the navigation bar on the left side of the screen provides a cascaded pull-down menu from which students can easily choose their lessons and appropriate interaction facilities needed. The position indicator on the upper side of the screen allows students to locate themselves during navigation and exploration.

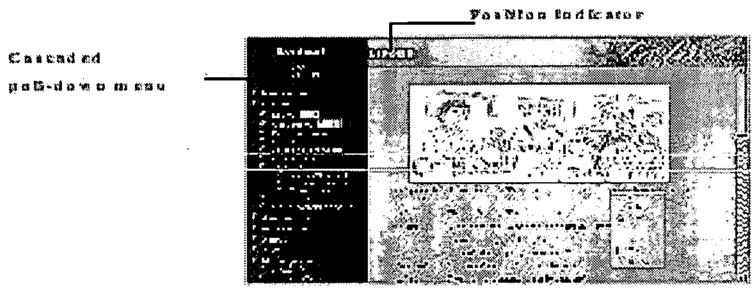

Figure 2: The User Interface

Conclusion

In conclusion, this study has presented the design and development of a Web-based multimedia instructional system for French language learning. The instructional system developed in the study appears to be one of the first instructional systems for computer-assisted French language learning in Korea. It can provide a learning environment where students can actively participate in the learning process through exploring and navigating the hyperlinked multimedia learning contents. This system has been successfully integrated into the existing curriculum and has been currently used in the foreign language courses. Furthermore, the interaction facilities of the system will be more expanded to make synchronous as well as asynchronous communications possible. Finally, an experimental study is underway to examine the effectiveness of the instructional system with regard to students' learning process and product.

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Instructional Design: WWW Diversity Resources

Ronald G. Helms, Ph.D.
Associate Professor
Wright State University
College of Education and Human services
374 Millett Hall
Dayton, OH 45435
SavantIII@aol.com

Colleen Finegan, Ph.D.
Associate Professor
Wright State University
College of Education and Human services
374 Millett Hall
Dayton, OH 45435
cafinegan@aol.com

Very clearly multicultural education is an important concept for both preservice and inservice educators. The U.S. macroculture is shared by all our the nation's citizens. Many cultural groups or microcultures are also part of the American Society. A goal of multicultural education is that a process of thinking will develop. Thus the authors have categorized several variables of multicultural education: age, belief, social class, exceptionalities, gender, language, ethnicity, and sexual orientation. The authors have carefully selected websites which represent various points of view in order to assist the student or educator in the process of thinking and in developing a multicultural perspective.

Addressing the Changing Roles ofTeachers and Learners in Internet-Delivered Materials

Yin Leng Theng
School of Computing Science
Middlesex University (United Kingdom)
y.theng@mdx.ac.uk

Introduction

Since its release in 1991, the World Wide Web (or Web)has changed the Internet to the extent that it has become almost synonmouswith the modern use of the Internet. In recent years, we are beginning tosee more and more open learning materials, distance learning programmes, virtualinstitutes, *etc.* springing up across the globe to cash in on these seemingly attractivebenefits. Organisations such as schools, professional bodies and businessesrecognising the benefits are also turning to internet-based mode ofteaching to enhance their learning programmes.

But, before we get so hyped up with this novel mode of teaching andlearning, we should really take a step back and askourselves these questions: how has internet-based teaching and learningchange the roles and relationships of teachers and learners? What are thesechanging roles? How can teachers and learners be helped to cope with thesechanging roles so that effectiveuse of internet-based materials can be realised?

Gone is the traditional concept that the teacher is thesource of all knowledge. In internet-based teaching, the teacher is nolonger the dictator of content and pace of learning.In other words, face-to-face teaching in the classrooms is replaced bylearners' interaction with learning materials through the Internetvia the computer monitor, replacing the teacher (Forsyth, 1997).In internet-based teaching, there is a shift towards learner-centredness,transferring the ownership of learning to the learners. Producing internet-delivered materials is not just simply putting coursematerials on the Internet, we need to address these changing roles andprepare teachers and learners for them, in order that the Internet iseffectively used for teaching and learning.

We learn from experience that many computer projects failed not onlybecause of poor *design* but also poor *delivery* in terms ofpreparation and training of people involved in the final systems(Ellington, Percival and Race, 1995; *etc.*). To address the changing roles of teachers and learners, this papersuggests doing things well both in the *design* as well as the *delivery* of internet-delivered materials.

Design Principles

Very often the criticism against internet-deliveredteaching is that the human element, that is the teacher, is absent andlearning becomes impersonal. A real challenge to designers is to retain asmuch of the traditional classroom"features" as possible in the design ofinternet-delivered materials, and to ensure that teachers and students seeits benefits, and to accept it as an effective, alternative form oflearning.

The second challenge to the design of internet-basedmaterials is to incorporate the well-accepted ingredients for successfullearning by (Ellington, Percival and Race, 1995): (i) making the materials stimulating and interesting enough to makelearners *want to learn*; (ii) incorporating sufficient activities tohelp learners experience *learning by doing*; (iii) providing sufficientchannels of *feedback* to the learners; and (iv) enabling learners to *digest and relate* whatthey have learned to the real world.

Theories in instructional design, constructivism, minimalism andhuman-computer interaction can be applied to translate these basicprinciples for successful learning experience into practical design:

- *Instructional design* represents asystematic, coherent approach to the design of computer-based instructionalmaterials. GagnŽet. al. (1979) propose thatlearning materials must include nine instructional events that shouldnormally be followed in sequence: (i) gaining attention; (ii) informinglearner of lesson objective; (iii) stimulating recall of prior learning;(iv) presenting stimuli with distinctivefeatures; (v) guiding learning; (vi) eliciting performance; (vii) providinginformative feedback; (viii) assessing performance; and (ix) enhancingretention and learning transfer.
- *Constructivism* proposes that the knowledge of the worldis constructed by the learner, making learning rather than instruction thefocal issue. If learning has a constructive character inherently, then it follows that teaching practices need to besupportive of the construction that occurs. Cummingham et. al. (1993) propose seven principles of instructional design: (i) embedlearning in realistic and relevant contexts; (ii) embed learning in

socialexperience; (iii) encourage the use of multiple modes of representation;(iv) provide experience and appreciation of multiple perspectives; (v) encourage ownership and voice in thelearning process; (vi) provide experience in the knowledge constructionprocess; and (vii) encourage self-awareness of the knowledge constructionprocess.

- *Minimalism*'s central idea is to minimise the amount of explicit instructionalmaterials, and that learning takes place in small steps (Carroll, 1990).Therefore, learning materials should be structured in a highly modular wayof self-contained units, allowing learners' strategies and preferences to drive the selection andstructuring of contents.
- Knowledge in *human-computer interaction* is important in helping designers to take into account human capabilitiesand limitations, and predicting how design choices might affect human.Design guidelines from human-computer interaction on text, graphics,colours, *etc.* are useful in helping designers to create interfaces that are clear,consistent, simple and uncluttered so that complex information can beeffectively perceived by learners.

The designprinciples discussed above have been used to teach ninety second-yearcomputing science students at Middlesex University (London). As part of theassessment, these student designers were asked to design and develop ahypermedia, computer-aided learning package incorporating established principles in human-computer interaction,learning theories and instructional design, and translating them intopractical design. These principles have, in general, been useful in guiding these novice student designers in the design anddevelopment of their learning packages.

Delivery

In a recent conference on "Educationaluses of the Internet and European identity construction" held in Strasbourg (France) in September 1998 (seehttp://in-tele.u-strasbg.fr), teacher representatives at the conferencefrom across Europe voiced their concerns that not enough is done to prepare teachers and students to use theInternet effectively. There is a general sense of fear and apprehensionamong teachers because they are not trained to use the computer andInternet for teaching.To avoid rejection of this new medium by teachers and students who are moreaccustomed to traditional classroom teaching, and find it difficult to giveup, education and training should be provided to address the lack ofconfidence in using the Internet as a teaching and learning tool. Teachers as well as students should betaught appropriate skills to use the Internet which include knowing how to search and query, transfer materials and files, use ofe-mails, chat and bulletin boards, computer-aided materials, *etc.*

Conclusion

This paper examined the changing roles of teachers and learners ininternet-based teaching and learning. Effective design and careful deliveryof the materials are some ways suggested to address these changing roles.Future work involves drawing up a framework for an application design modelfor developing hypermedia materials for teaching and learning. The aim ofthis framework is to provide designers with some sort of a checklist toensure thatdesign issues crucial to the successful delivery of internet-basedmaterials are considered.

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Evaluating collaborative telelearning scenarios: A sociocultural perspective

Frode Guribye & Barbara Wasson

Department of Information Science, University of Bergen, N-5020 Bergen, NORWAY
Frode.Guribye@ifi.uib.no Barbara.Wasson@ifi.uib.no

Introduction

In this paper we discuss work in progress by describing the conceptual framework we are using to identify patterns of collaboration in collaborative telelearning scenarios within the Norwegian project DoCTA (http://www.ifi.uib.no/docta/). Project DoCTA focuses on the design and use of artefacts in collaborative telelearning scenarios aimed at teacher training. Various scenarios utilising the Internet are used to engage the students in collaborative learning activities. An ongoing exploratory study is analysing four different scenarios.

In the first scenario, a pilot study is analysing the use of Teamwave Workplace (http://www.teamwave.com/) for collaborative activities in a graduate university course[1] at the University of Bergen (UiB). The next two scenarios involve European inter-cultural simulations where the goal is to design a textual artefact (such as a treaty or policy statement). In IDEELS[2] teams of Norwegian students at UiB and Nord-Trøndelag College (HiNT) collaborate with teams in Germany, Spain and France to develop a treaty. In Demeter[3] Parliament, Norwegian students at Stord/Haugesund College (Stord) collaborate with students from 13 countries to contribute solutions to contemporary problems facing the European community. In VisArt, a fourth scenario being designed, developed and deployed for use between Norwegian educational institutions, the goal is to design a visual artefact to be used in teaching a subject of choice. In this scenario, teams will comprise students from the three Norwegian participating educational institutions (UiB, HiNT and Stord).

Collaboration Patterns

From a research perspective, the exploratory study being carried out within DoCTA will provide us with insight into the processes of collaboration enabling us to identify collaboration patterns and further our understanding of how instructors, students and other learning facilitators organise their learning and work.

The community of study includes teachers, learners and facilitators participating in the various collaborative telelearning scenarios. The main research question has been formulated to ask how these students, teachers and facilitators organise their learning and work given the different scenarios. The four collaborative telelearning scenarios vary with respect to: (1) actor characteristics (e.g., within a common community vs. disparate and divergent cultural backgrounds; similar knowledge and preparation vs. different knowledge and preparation; etc.); (2) aspects of the learning activity (e.g., text based vs. visually based; well-defined learning tasks and goals vs. ill-structured tasks and goals; etc.); (3) the kinds of artefacts they have access to (e.g., the artefacts provided in the various internet environments[4]); and (4) the kinds of artefacts they are to design (e.g., textual or visual).

Conceptual approach

The underlying conceptual framework adopted in this research is taken from three different, although closely interrelated approaches, namely: activity theory (Leontev, 1978, Engeström 1987), distributed cognition (Hutchins, 1995), and situated action (Suchman, 1987, Lave, 1988, Mantovani, 1996). One of the goals of this research is to argue that, together, these approaches make up a rich framework for describing, evaluating and analysing collaborative telelearning scenarios. All three approaches underscore the need to look at *real activities* in *real situations* (Nardi, 1996, our italics), and always, in some way, include the context in studies of human activity.
The rationale for combining these three approaches as the conceptual foundation of this study, is that they all fall under what is called a sociocultural perspective (Wertsch, del Río & Alvarez, 1995), that highlights learning and thinking as phenomenon that can not be studied in isolation. Rather, they are complex processes situated or distributed in an environment — it is impossible to separate them from the context in which they occur. The different approaches each emphasise slightly different elements of the framework that is important to be aware of

[1] http://www.ifi.uib.no/staff/barbara/courses/host98.html
[2] http://ftp.uni-bremen.de/wwwgast/fzhb/ideels/public_html/index.html
[3] http://hugin.hsh.no/prosjekt/demeter/index.htm
[4] E.g., in IDEELS the artefacts they have access to include their own email system, Teamwave Workplace, and OPUSi a web-based conferencing system developed at the University of Bremen, Germany.

in these kinds of studies. Situated action emphasises the emergent, contingent nature of human activity, the way activity grows directly out of the particularities of a given situation (Nardi, 1996). Distributed cognition on the other hand, asserts as a unit of analysis a cognitive system composed of individuals and the artefacts they use (Hutchins, 1991, Nardi, 1996). This approach underscores the distributed nature of cognitive processes, and the role that different artefacts play in these processes. Activity theory also emphasises the mediating role of artefacts, but stresses that these artefacts carry with them a particular culture and history, thus, focuses on the institutional and cultural elements involved in the learning activity (Kuutti, 1996). Adoption of these approaches provides a strong and fruitful conceptual framework that informs the evaluation of collaboration patterns in collaborative telelearning scenarios.

Evaluation approach

The evaluation aims at a naturalistic study of how participants in collaborative telelearning organise their work and learning activities. Ethnography (e.g. Hammersley & Atkinson, 1983) influences the design of our evaluation approach including the choice of data collection (e.g., participant observations, unstructured interviews, video recordings) and analysis techniques (e.g., discourse analysis, video analysis). This means that the evaluation is an iterative process where an ongoing analysis guides the data collection emphasis in successive phases.

In order to collect data about the activities that the students engage in during their participation in the scenarios, different methods and techniques will be used. The most important sources of information will be derived from observing the students as they collaborate and interviewing them, and also from electronic logging of artefacts used for collaborating (e.g., email, shared whiteboards, chats, to-do-lists) and artefacts designed (e.g., a web page) during the collaboration. It is a challenge to carry out the participant observations since a large number of the students are geographically distributed over Norway thus direct observation of all the students is unrealistic and too costly. Rather, an alternative technique consisting of immersing ourselves in the virtual environment in order to observe their activities will be used. For this reason, the electronic data logs will be an extremely important supplement to the "online" and "offline" observations. The data being logged, is not just statistical data recording who is logged on when, but includes a periodic chronological recording of all artefacts in the environment. This means that we can recreate versions of the environment to study the use of artefacts over time and the creation and development of the artefacts produced in the collaboration process. Data collected in the fall of 1998 has been analysed and used to inform the data collection in the spring 1999 scenarios. At EDMEDIA'99 we will be able to provide a preliminary report on our findings.

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Computer Literacy in the Information Age

Morfin Otero, Francisco
fmorfin@iteso.mx
Ortiz Michel, Gabriela
gabi@iteso.mx
Information Technologies and Education. DESI.
ITESO University, México

1. The Transformations of the Individual

Historians of technology show us in myriad ways how the arrival of technology changes the conception that individuals have of the world, the relationships with the objects that surround us and social relationships (Delfgaaw 1975). We can distinguish different levels of transformation, depending on the impact of the technology itself (Attali 1985). Information technologies are already announcing a veritable revolution: the information revolution. This is an unfinished revolution that forms part of the worldwide tendency toward societal acceleration, a re-figuration of identity and our place in the world (Morin & Kern 1993), and a reduction in the restrictions of time and space, at least, in communicational transactions (Tiffin & Rajaasingham 1996).

Our relationship with information has two basic dimensions: operation and representation. In both cases, the information refers to the object being spoken of, and also to what is being said about the object.

In the *operational dimension*, we manipulate information to extract data on the object being referred to. We operate the information in order to get more information; in this way, information is understood as "a difference that makes a difference" (Bateston 1985). Operating information requires a previous question that imposes intention upon the action of operation.

The *representational dimension* has to do with the products that result from operating information; it is its expressive dimension. The representation contains an internal reference to the intention of the individual expressing it and another external reference linked to the questions of the individual receiving the information. In both cases there is an object of information constructed multi-dimensionally according to the socio-cultural codes of the people involved. In this way, information is a communication bridge between individuals that are expressing the world, and therefore, expressing themselves. Here is where a first level of transformation appears, in the relationship with others derived from information technologies: what it allows us to represent.

A second level has to do with the way it allows us to represent. Information technologies are intrinsically linked to the communication technologies that enable communicational expressions to take place a different way: the object expressed by one person can be manipulated by another, using the representation itself.

So our relationship with information (operation and representation) and with others (communication transactions) is transformed by information and communication technologies in all aspects of our lives. That is why we consider it important to identify the elements that make an individual computer literate, so as to propose an appropriate literacy process.

2. Computer literacy

In the human-computer interaction, we find a process that begins with a casuistical exercise of action upon the tool, and that leads up to the integration of the tool as part of the environment of "action upon the information". We understand this process in the following way:

The process of computer literacy begins with a casuistical interaction of the person with the tool, which manifests itself as "I want to... How can I...? Do it..." In time, the individual begins to identify a set of patterns that organize his actions when interacting with the tool.

Several patterns organize interaction with informational tools on a level at which these tools are seen and operated as artifacts for completing tasks without necessarily being integrated into daily activity as an integral part of the individual's environment.

The *organizational and representational patterns* refer to the interface structures that allow us to understand what can be done with the artifact. These are structures that appear in such a way that they make clear how the computer functions internally. In this way, we find "iconic" organizations in the graphic environments that describe what is immediately possible, and indicate the most common actions.

The *patterns of objects and their structures*. Computers contain objects, each one made up of defining attributes and other objects. A document is an object whose attributes are those definitions applied to each of its parts. It might contain sections with specific attributes that are different from the attributes of other parts of the document. One section contains paragraphs each paragraph contains words, and these contain letters. An object's attributes affect all of its parts except those made up of objects with their specific attributes

As for the *pattern of processes,* they allow individuals to organize the set of actions that they carry out to achieve what they want. There is a process pattern that we could call "second-level" inasmuch as it refers to the process for knowing the process for doing what I want to do. It is the search process we apply every time we do not remember all the steps for obtaining a specific result.

On this second level of patterns constructed by the individual for interacting with information tools, one might be skillful at operation without necessarily being computer literate. This is achieved on a third level where among other things, the person consciously proposes the production of different representations of the object in question in order to know it better, to know more about it.

This level is made up of the combination of two patterns: the handling of information in such a way that implies intentional action upon the object referred to, which is an exercise in reorganizing and processing information; and the pattern of metacognition that allows individuals to account for the way they produced what they produced. This third level, organized on the basis of the individual's intention, implies opening new horizons of possibility.

So the computer literate are those who can conceive of information and communication tools as part of their environment and operate them as such intentionally in the search of more knowledge about the objects referred to by the information they are manipulating and expressing.

3. The computer literacy process

The essence

The computer literate that we are describing is basically an apprentice, intentionally looking for more knowledge. This leads us to take a look, especially in formal education, at the way the individual conceives and operates "how to know". We identify two key elements, and educational strategies must be devised to activate them: 1. The individual's intention., as the origin of any process. 2. Metacognition. As a substantial element that gives the individual a reference point in his or her process of knowing.

Skills for handling information

We are talking about an individual that searches for more information: he or she proposes various representations of these objects in order to know them better. In this sense, we cannot conceive separately computer literacy from information literacy. If a person is not already information literate, then when educating for computer literacy, we have to educate for information literacy as well.

Tool work in spite of technological change

In the computer literacy process we should recognize that the capacity for tool work should be immune to technological change. The patterns described conform a model that should be worked on three different levels:

1. Identifying the patterns: Individuals approach to technologies is quickly and systematically.
2. Operating patterns: Individuals use the tool for their particular purposes. It implies that the individuals have the capacity to build and rebuild work strategies around their own purposes.
3. Appropriating, rebuilding and applying the model and the personal way of operating it: Individuals move among different platforms and continue to operate in spite of technological change.

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Mobile Multimedia Classroom Project - Genius Loci

Ward M. Eagen
Architecture Technology
Sheridan College
Canada
ward.eagen@sheridanc.on.ca

Wendy Cukier
Information Technology Management
Ryerson Polytechnic University
Canada
wcukier@acs.ryerson.ca

Project Description

This paper is a case study of the technical trial for the development of mobile multimedia technology to create a virtual learning space on the World Wide Web (NOMAD – New Online Media Alternate Delivery). The subject of the trial is the genius loci, or spirit of place, of rock art to support a college level Architectural History course. The fundamental notion is that architecture is the 'gift of creating places for ritual' (Kostof, 1995) and that the act of creating a place with a handprint is the beginning of architecture. In part, this project is an exploration and contrast of the first notion of 'place' (Casey, 1998) as created by the first technologies with the current notion of 'place' created by current technologies, for example cyberspace (Meyrowitz, 1985).

The format in which the material is presented is intended to generate interest and enhance participation. Real time processing and presentation of material through the web is used to create a sense of participation in the adventure. The journey unfolds as a story in serial form: Like a novel by Dickens published in weekly installments, and is intended to whet the appetite and create expectation for the next installment. The general structure is in the form of a serial narrative (Murray, 1997) with a beginning, middle, and end but with each phase indeterminate, unfolding as a journey in real time. The NOMAD Project is similar to a number of on-line virtual adventures, for example, Terraquest's Virtual Antarctica, but is focused specifically on the significance of place and ritual in the making of architecture.

Architecture

Architecture as the 'first art' is a gift of the gods. Inspiration is the 'breathing in' of the 'genius', the spirit of the Muses (Frye, 1957). Both Humans and animals live in caves but animals do not have architecture. Homo Faber - Man the Maker changes his environment to support his activities, understanding the distinction between utility and meaningfulness expressed linguistically as the difference between "in order to" and "for the sake of"(Arendt, 1958). For example, making a fire pit to support cooking and heating is more than just functional. The technology creates a place of social gathering forming a group with a hierarchy as expressed in each individual's relationship to the fire. Caves are perceived as connections to the underworld and the womb of mother earth. By placing one's handprint on the cave wall, one participates in the mystery of life. The simple act of making rock art marks the place as special spiritually and elevates the cave to the realm of architecture.

The Cartesian notion of space and its relationship to time (Casey, 1997) is distinct from my use of the notion 'place' and its relationship to 'event' which is fundamentally phenomenological. Cyberspace is a misnomer. All that is required for the concept of space is the definition of boundaries and limits. The universe as limitless space is curved conceptually providing a boundary. Place always involves human agency, even if it is as minimal as giving a name to a space. Death Valley has a history and image that makes it a 'place' in our culture. Any material intervention that supports this iconography is architectural. Cyberspace does not meet the physical requirements of space but it can be thought of as place, or Cyberplace as it meets the phenomenological requirements.

The Aesthetic of the Digital Environments

Murray (Murray, 1994) has documented the three principal notions that enhance the experience of digital environments as immersion, agency, and transformation. Immersion is the ability for consciousness to get 'lost' in the environment as in being 'buried' in a book. Agency is the ability to impact outcomes. Transformation is the ability to 'play' at being something else, often with cathartic effects. How can these pleasures be exploited in NOMAD and to what end?

Immersion is a measure of interest in the content (Murray, 1994). It can be enhanced through quality graphics and text and the narrative structure of a journey that generates a beginning, middle, and an end. The unfolding nature of the serial delivery generates expectation in what comes next. Key is the timely generation of data and its mounting on the web site.

Agency promotes ownership (Murray, 1994). It is enhanced through quick responses to online queries with answers from the field and participation in the online forum. A notion of the project is that students will do research in specific areas that will generate questions for field investigation and therefore have an impact on what happens next. Agency in the interface can be enhanced through the use of QuickTime VR which allows the user manipulation of view and through the use of live video of locations from which the participants can capture images as they chose.

Virtual transformation often produces cathartic effects that generate real transformation (Murray, 1994). The hope is that by being a virtual traveler one will become a real traveler and go to the sites visited virtually. By researching a specific area of the content, participants break down the barriers between student and teacher. By being a member of the virtual team, the participant develops real team skills.

Responding to the aesthetic of the new media and enhancing notions of immersion, agency and transformation in the construction of the digital environment will, I believe advance pedagogical objectives through increased participation and user satisfaction.

Further Research

The unique elements of NOMAD include:

- Using multimedia in near real time to communicate sense of 'place'
- Using a narrative structure to organize course material
- A roving or mobile instructor developing and delivering content from remote locations
- Integrating a variety of relatively new multimedia applications and wireless technologies
- Operating under remote and technology challenging conditions

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Current Approach to Multimedia Interface Design

Maria Lorna A. Kunnath
Doctoral Candidate
University of Central Florida, USA
mak05307@pegasus.cc.ucf.edu
lorna518@juno.com

Introduction

The computer has come a long way from a device that merely performs mathematical calculations for science and engineering to a device such as multimedia systems that can mimic the mental and sensory abilities of a human (Dannenberg, R. and Blattner, M 1992). Multimedia systems have made possible the different representation of information in a variety of ways. Through its interface, multimedia has made possible the interaction with these various forms of information through the various human senses. Multimedia interfaces uses multiple media viz. language, graphics, animation, video, non-speech audio, to communicate with users (Roth, S. and Hefley, W. 1993). Research in this area consist of a few studies involving the effect of using various combinations of media on the user's performance offering little for clear cut designs for mixing media. Multimedia generation entails the following processes:

1. Selecting the content of the information to be communicated
2. Choosing what media to use in order to communicate the information
3. Deciding how to present the media
4. Coordinating the presentation of the various selected media

Just like in a movie where the effect of the medium depends highly on the proper mix and relationships of the script, choice of characters, storyline, cinematography, music and setting, multimedia processes raise issues on the optimal mix and relationships between the various formats, use of models, metaphors, navigation, input and manipulation, synchronization and exploitation of new media (Blattner, M. 1994). This is because historically, design of interactive multimedia is driven more by intuition rather than empirical research (Park, I. and Hannafin, M. 1994; Faraday, P.M. and Sutcliffe, A.1997). This is exacerbated by the designers not being aware that design principles exist. This optimal mix issue is dealt with through empirically guided principles formulated by Park and Hannafin, Faraday Sutcliffe and, through tools for presentation with embedded expert systems in the field of artificial intelligence.

Multimedia Interface Design Principles

Park and Hannafin formulated 20 research-based principles for designing interactive multimedia. These learning principles are empirically rooted in the psychological, pedagogical and technological domains. The psychological principles provide important insights into how individuals think and construct meaningful learning. These are based on theories such as schemata, meaningful learning, elaboration and situated cognition. The pedagogical principles combine's Gagne's taxonomy of learning and learning outcomes, Ausubel's theory of advance organizer and Mayer's theory of meaningful learning. Together they form the structure for multimedia teaching and learning environment. The technological principles are meant to provide a vision on how future technologies will influence the teaching-learning systems and the changing role of the teacher and the student. These serve to suggest improvements for creating more powerful and efficient technologies for the future. These 20 principles are intended to root and strengthen multimedia in contemporary research and theory without unnecessarily constraining the multimedia designer's creativity by limiting them to conventional thought. However, it would be equally unwise to allow multimedia designer to continue their design approach without due consideration to human processing and cognition (Park and Hannafin 1994; Blattner, M. 1992).
Peter Faraday and Alistair Sutcliffe (1993) drew up guidelines for designing multimedia interface for the Esprit INTUITIVE project consisting of four components viz.:
1. creation of a task model with information requirement specifications

2. Resource Model describing the media available
3. Selecting the media appropriate for the task
4. Scripting a coherent dialogue combining information in different media

In another project, 'Etiology of Cancer', Faraday and Sutcliffe (1997) tackles the design at a micro-level through a "moment-by-moment selection of appropriate media in response to specific cognitive needs and task requirements".

Intelligent Multimedia Interface

An Intelligent Multimedia Interface such as the Intelligent Multimedia Presentation System IMMPS basically assists the multimedia system designer by collecting the information and the goal for communicating that information to the user which are then matched up with IMMPS archive of alternative media and presentation techniques (Roth, S. and Hefley, W. 1993, Shih 1997a and Shih 1997b, Bordegoni, M. et. Al. 1997)). The laboratory prototypes developed are of the type that generates coordinated multimedia presentations such as WIP which presents and understands combination of graphics, text and pointing gestures with the capability of interpreting questions and designing multimedia answers (Andre, E. 1997). The PPP Personalized Plan-Based Presenter which creates a script with an accompanying method to present the material (Andre, E. 1997). There is the Columbia Operations and Maintenance Explanation Testbed COMET which automatically designs integrated textual and 3-D information (Shih, T. 1997). The SAGE automatically creates business graphics display. The TEXTPLAN provides narrated animations of directions over an object-oriented map. AIMI involves the user into a multimedia dialogue and produces graphics that the user can interact with.

Conclusion

With a complex time-varying nature of multimedia elements, issues for further research and investigation of multimedia interface will continue to be multimedia input and output (Roth and Hefley 1993, Blattner and Dannenberg 1992), navigation , visual design (Hannafin, M. and Hooper, S. 1989, Grabinger, S.1989, Lucas L. 1991), media allocation (Maybury, M. 1993; Arens, Y., Hovy, E. and Vossers, M. 1993; Faraday. P.M. and Sutcliffe, A.. 1997) and integration of media (Roth and Hefley 1993). To be generalizable, the already existing models and tools need to be validated and tested on a variety of design settings and on different types of users.

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Handling the browser-searcher paradox in web-design

H. van der Meij
University of Twente, Department of Instructional Technology
P.O. Box 217
7500 AE Enschede, the Netherlands
meij@edte.utwente.nl

J. J.K. de Vin
University of Twente
P.O. Box 217
7500 AE Enschede, the Netherlands
J.J.K.deVin@student.utwente.nl

Some visitors of a website, browsers, simply want to become acquainted with a topic. They browse the home page and click topics to see what further information the site has to offer them. The success of the site partly depends on enticing these visitors to continue the exploration. The success also partly depends on conveying the site's underlying structure. The browser should get an impression of the ways in which the topic is treated.

Other visitors come to the site with a distinct question in mind. These visitors, searchers, are focused on getting a specific answer to their question. They want an immediate answer and they do not want to have to click through several layers of information or (sub)topics to get it. The site is a success for these visitors if it gives a comprehensive and correct answer without requiring an inordinate amount of energy in delving it up.

Its not easy to serve both audiences as what attracts the browser may repel the searcher. In this paper we sketch our attempt to handle the browser-searcher paradox in designing a website on technical documentation. The design approach we have adopted for dealing with this issue is known as minimalism. Minimalism has been used predominantly for supporting the (new) user of software programs such as word processors and object-oriented programming languages. Due to the limited space that is available for describing our design, we discuss only the major design principle to anchor the topics in the task domain. Also, we concentrate on a single topic within the domain, namely screen captures.

A key design principle is that the site structure - the number of levels and the division within levels - should reflect the underlying domain structure. Some topics about technical documentation can be treated in a single level. For example, the statement that quality writing evokes quality reading is treated simply as a nice-to-know fact appearing only on the Home Page to entice browsers. Other topics need stratification. Screen captures are such a topic. Screen captures can be characterized according to their general appearance (i.e., design) and function (i.e., role). Typically, the design or role of screen captures requires further specification to support the work of a designer of technical documentation.

The treatment of screen captures begins not on the first or on the second level of the website but on Level 3, the Theme Page (see the Figure). The reason is that the topic represents a rather specialized part of technical documents. Along with other parts such as a goal statement, one or more action steps, and possibly some problem solving information, a screen capture - or some verbal equivalent - is a constituent element of a procedure. The main function of a screen capture is to support the joint handling of manual, software and input device. For example, a screen capture may give feedback with which the user can check whether (s)he is still on the right track. In other words, screen captures give coordinative information. As this kind of information can also be given verbally, there is a need to compare and contrast these modes in delivering coordinative information in procedures. This explains the rubric and its organization on Level 3.

The stratification on the levels 3 and 4 complies with the taxonomy of screen captures. The Theme Page gives a comprehensive treatment of screen captures, briefly describing and illustrating the main design dimensions and roles. The Case Page details each of the four dimensions or roles. For example, users who turn to this Page for information about coverage see a page with an identical lay-out and structure as the Positioning Case Page. In addition, the organizer with brief descriptions of the four design dimensions remains on top of each of these pages to convey the impression that these dimensions all lie on the same level in the hierarchy.

A special problem with the presentation of screen captures on the Theme Page and the Case Page is that there is a conflict between the preferred technical solution for displaying pictures on the website and our design philosophy. All experts that we consulted on the question of how to display the (many) pictures (screen captures) along with the explanations suggested that we use clickable thumbnails on the Page. Clicking the thumbnail would then display the larger picture. This is strongly advised against in our design approach. What belongs together should also be presented together. Thus we sought for another (technical) solution. One of the two design options that we have come up and that keep picture and explanatory text together is using an expandable thumbnail. That is, the visitor can simply enlarge the picture by clicking and dragging a corner. The result is that the text is pushed downward, but still remains on the same Page (or level).

Surely, there is a need for people to see how screen captures fit into a wider context. For screen captures this context is a procedure which is always a main component or chunk of information in technical documentation. Therefore, the topic is treated on level 2 which is characterized as a Procedure Environment to signal the wide variety of topics that one should expect to be discussed here. Screen captures also make their appearance on the first level, on the Home Page. On this Page the browser is given a preview of a set of rather diverse screen shots - in thumbnail format - to enhance the attractivity of that page and to invite the person to explore that (or another) element of a procedure.

Website level & Name	Description	Content
Level 1: Home Page	Visitors are informed in an attractive way of what this site has to offer. All Environments are introduced. Some themes and Cases are illustrated with an example.	Environments - Testing - Design approaches - ***Procedures*** - ***Screen captures- preview***
Level 2: Environment Page	Visitors are shown how each Environment is structured or organized. Typically, these structures are based on validated taxonomies or typologies.	Procedures - Conceptual information - Constructive information - Corrective information - ***Coordinative information***
Level 3: Theme Page	Visitors can get to know the main topics within a Theme. Typically there is an overview, a limited set of examples, a recap of the wider context, a discussion of research, and a preview of 'more details'	Coordinative information - Textual variants - Screen captures - roles - ***Screen captures - designs***
Level 4: Case Page	Visitors receive the basic facts about the topics in a theme. There is a definition, an exhaustive set of (annotated) examples, a discussion of design variations and related research findings, and a section on design considerations	Screen captures - designs - Cueing - Size - Positioning - ***Coverage*** - ***Full vs partial screens*** - ***Use of context***

Many topics are still to be resolved. One of these concerns finding a way of making it easy to access information found on the deeper levels of the site (we limit the site to four levels, as shown for screen captures). An option we are considering here is using a special form of a preset query system to direct searchers quickly to the relevant Level and topic. For example, the searcher should be able to reach level 3 or level 4 directly from Home by responding to the query "I want information about ..." with respectively "screen captures", or "positioning screen captures".

In creating our website we have led our choices be affected by the following main factors: usability issues (e.g., what is the audience, what do visitors want) topical or domain characterizations (e.g., taxonomies or typologies), the minimalist philosophy with its corresponding design principles and heuristics, and finally, technical considerations (e.g., the decision to abstain from using plug-ins to serve a wider audience). We have found the approach meaningful but also progressing only slowly. This is what can be expected in minimalism. It simply takes a lot of time and effort to create a website that allows people to do more with less.

DATABASE-DRIVEN WEB APPLICATIONS FOR TEACHING & LEARNING

Daniel Y. Lee
Department of Economics & Coordinator, the Virtual University
Shippensburg University, Shippensburg, PA 17257 USA
DYL@ship.edu

1. Introduction

Although many instructors now utilize the Web to supplement their courses, the Web pages they create are mostly "static" in nature. These HTML documents are written and then posted onto the Web server, where they sit until requested by a browser. Materials on these documents are outdated overtime until the Web developer revises them one page at a time, which requires considerable time and effort, especially as Web pages multiply. In the long run, a better strategy to maintain a Web site is to use "dynamic" pages linked to databases. These Web pages are "dynamic" in the sense that they are created "on the fly." They don't exist until a browser makes the request. Upon the information user's request, the database inserts the requested information into preformatted HTML templates. If the information in the database is updated, the Web page will display the new information the next time it is requested by the user. The purpose of this paper is to provide an overview of how educational Web sites can be more easily administered, modified, and customized by using Web-database connectivity.

2. Developing Database-Driven Web

2.1 Advantages of using database-driven Web

Web browsers provide a Graphical User Interface (GUI) that can be used to access many things, including a database. Unlike the traditional database management systems, the user would not have to configure and learn to program database client software. Instead, using a Web browser's built-in forms capability, users can access a database by simply filling in the data they want and pressing a button. The returned data can then be presented in an easily readable format. Furthermore, the Web's cross-platform support allows users on many different types of computers or platforms (Windows, Mac, Unix) to access a database from anywhere in the world. Information can be disseminated with a minimum of time and effort, without having to solve compatibility problems (Lee and Liu, 1998).

There are several advantages of using database-driven Web development over the conventional "static" Web pages. First of all, Web pages can be created "on the fly" by querying current information stored in the database. New and fresh information can be presented to the user at each visit. This technology also makes it easier to administer, modify, update, and customize a Web site. In addition, users can tap into vast existing databases including many legacy systems through Web-database interaction. This allows for cross platform access without requiring custom client applications. Furthermore, database-driven Web makes it possible such useful functions as maintaining user state, i.e., user's preferences and other user-specific information can be stored between visits for various uses. In addition to these benefits, database-driven Web renders particular advantages to educational Web sites. Databases are "an excellent way to manage the media components of a Web site … instructional Web sites comprise huge numbers of media objects and multiple of content creators; databases make managing this information and longer-term maintenance issues easier to address" (Ashenfelter 1998).

2.2 Mechanism of database-driven Web

Typically, the Web server delivers a block of text written in the HTML to the browser, which parses the HTML and may request additional content, such as graphical data. The model works well for static data, but what about live data? For example, how would a Web server deliver content that it generates based on user input? One answer is to use a CGI (Common Gateway Interface) script to handle the database queries. CGI scripts are programs that let Web servers execute other programs and incorporate their output into HTML documents. The Web server executes a CGI program as a separate process to fulfill a user's request, which can be as simple as a Web page hit counter or as complex as a database query. Because a CGI program is external to the Web server, it can be written in virtually any language, whether compiled or interpreted. Some Web servers provide libraries and interpreters for Java and Visual Basic for use by CGI programs.

While CGI programs can handle basic Web-database connectivity functions, programming requires a steep learning curve. CGI programming is also subject to such limitations as input data validations and weak security. Recently various "middleware" products have been developed to minimize the CGI programming time and additional features of Web-database connectivity, including superior security, input data validation, e-mail protocol, etc. Middleware is a general term for any programming that serves to glue together or enhance two separate programs. Users now can create Web-database applications by using a fourth generation language middleware products such as Cold Fusion or Active Server Pages.

Database-driven Web publishing involves three major components: the Web forms, CGI or middleware, and database system. The mechanisms for Web-database interaction are shown schematically in Figure 1. There are four major stages in this interaction. First, the user fills the Web form using the browser, requesting pertinent information. The browser submits the request to the Web server. Second, the server invokes middleware or CGI scripts, accessing and querying the database. Third, the middleware or CGI retrieves or produces a HTML document. Finally, the Web server sends the result to the browser for display. CGI script or middleware makes it possible for the operations such as opening and updating appropriate database tables to link form objects to a database structure specified in the database design. The Web server and database server can be hosted in a single computer or two separate machines connected through the Internet.

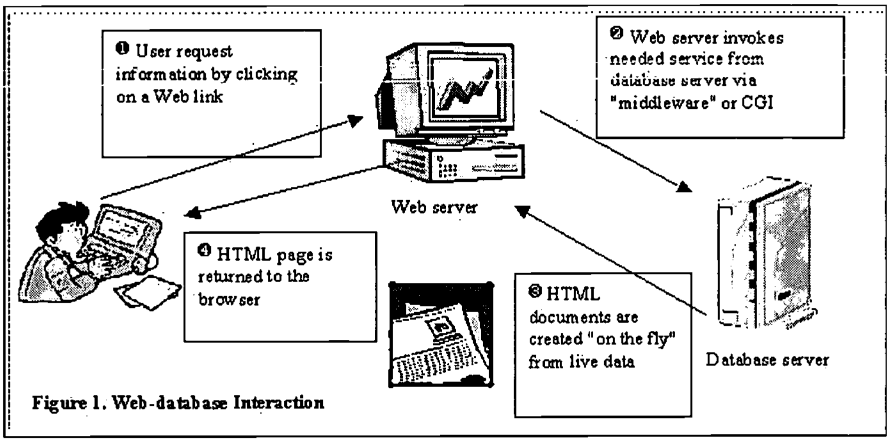

Figure 1. Web-database Interaction

2.3 Design of a database-driven Web

To design an effective database-driven Web, three major design activities must be performed, including Web form design, database development and CGI or middleware programming. Web forms are necessary as a user interface for a database-driven Web. The information user can send a request to a database by submitting it via Web form. A relational database is composed of rows (for records) and columns (for fields) in table format. Compared with a flat file structure, database approach has the advantages of minimal data redundancy, information sharing, and data consistency. Finally, some programming is required to connect the Web forms and databases. For example, Active Server Pages utilize extensively Visual Basic programming knowledge. Visual InterDev utilizes more user-friendly graphical interface. Cold Fusion eliminates some of the complex CGI coding by combining standard HTML with a server-side markup language called the Cold Fusion Markup Language (CFML). For example, the CFML tag <CFQUERY> can replace many lines of CGI programming codes. In addition, Cold Fusion supports such advanced features as security integration, dynamic Java forms, data entry valuation, e-mail integration, Lightweight Directory Access Protocol (LDAP) support, and advanced SQL (Structural Query Language).

3. Conclusion

Static Web documents are cumbersome and time-consuming to maintain. Whenever part of the contents is changed, the Web pages need to be updated. While dynamic Web development may require greater up-front costs, these database-driven Web pages will minimize the cost of providing up-to-date materials to the information user in the long run. Instructors can simplify the means of adding and updating materials on the Web by connecting their Web pages to databases. Carefully designed database-driven course Web sites can significantly enhance student-teacher interactions without taxing heavily on the instructors' valuable time and effort.

CHEMISTRY ON THE WEB

Dr. Leon L. Combs
Department of Chemistry
Kennesaw State University
U.S.A.
lcombs@ksumail.kennesaw.edu

This paper will focus on two applications of web technology to learning chemistry: the development of web sites for students to use for the understanding of particular topics in a physical chemistry course, and the use of web supplements for students in freshman chemistry and physical chemistry lab.

I. WEB SITES FOR UNDERSTANDING PHYSICAL CHEMISTRY CONCEPTS

The author is developing several different sites for use in the teaching of a two-semester course in physical chemistry. There will be a physical chemistry main site called the web "handbook" for the course and there will be many other sites called introductory sites. The on-line "handbook" being developed will reference introductory sites so students can make optimum use of their on-line time. The "book" will include the use of many topics which the students can "click on" to go to one of the introductory sites for further study.

students who do not know the topic can go to the site for an in- The introductory sites will contain rather complete introductions to concepts involved in the physical chemistry course, and will include examples of applications of the concepts. The author is particularly concerned with the students' metacognitive development, and these introductory sites will attempt to clearly show how the understanding of the concepts is developed so that further applications of the concepts should be easier. Those students who are already familiar with the particular topic can ignore the site or go to it for a quick review. Those depth study of the concept.

To help students judge their level of understanding of the introductory topic, java-based concept tests will be available which provide instant feedback to the student. A certain level of understanding is recommended before the student should proceed to further studying in the handbook. If the student performs below the recommended level then he/she should return to the introductory topic for further study and a retaking of the concept test. Once the student has achieved a satisfactory score on the concept test then he/she should be prepared to proceed to the topic development in the handbook. The handbook will also have problems for the student to work in applying the concepts.

For an example, one may go to this site (http://stern.kennesaw.edu/~lcombs/inter) and see how intermolecular forces are discussed for those who need a review or for those who seek a more complete study of an introduction to this concept. This introductory site would be referenced from the on-line handbook which further develops applications of the concept of intermolecular forces.

Will there continue to be a hard textbook for the course? At this point the answer is yes for the "handbook" is presently being developed as a supplement to a standard textbook. However as the "handbook" further develops it is possible that it will become the only text and it may be in the form of a web site or a CD, either of which would reference the introductory sites. The author envisions the introductory sites remaining as web sites since they can easily be modified as the need arrives.

It is possible that this method of study can be extended for use in courses taught entirely, or mostly, via distance education. We are developing videos of pre-lab lectures so that students can view the pre-lab lectures at any time and from any place, and as we develop our techniques of video presentation over the web, we plan on making use of the technology for lectures also. The web-based video lectures will use an Elmo for showing what would be done on a chalk or white board. Although it is difficult to imagine physical chemistry being taken totally as a distance education course, it is possible that a market for such could develop. We do anticipate offering a course in Chemical Literature and a course in General Chemistry about 90% over the web by next fall using this video technology and web-site technology such as will be described in part II. The students will have to come to campus or other proctored sites for tests.

This short talk will show portions of the "handbook" and portions of some of the introductory sites. It is hoped that by the time of the meeting that some video portions will also be ready to demonstrate.

II. Web Supplements in Chemistry

The author has been using a platform called Web-Course-in-a-Box (WCB) for a couple of years. WCB is being developed at Virginia Commonwealth University and a commercial company has been formed for further development and sale of the product. The author has used WCB for freshman chemistry, a senior seminar course, and for physical chemistry labs. WCB contains six components: a section on the class roll which allows for e-mail to be sent to all students and allows the students to develop portfolios for the course, a section for announcements, a section for the class schedule, a section which allows the students to make their own web page and to obtain help using WCB, a section on class information which can be anything relating to the class including web sites or class notes, and a section which can contain multiple bulletin boards and a fully developed lesson for the course. The section for the bulletin boards is very useful in that many bulletin boards can be formed by the professor. Separate bulletin boards may be formed for each small group within the class so that only members of that group can use the bulletin board. The small group boards are very useful for group projects.

The author has found WCB particularly useful for a university such as KSU which is a commuter university of about 13,000 students. Most of the students work and they find WCB a very helpful way of working on small group projects, taking concept tests, and finding notes for classes that they have missed. They can assess the web site after they leave work at 3:00 a.m., read missed notes, send e-mail to a study partner or to the professor, and work on the bulletin board project with their partners.

KSU is changing to WebCT this summer but all of the advantages of WCB are applicable to WebCT which has more functionality and is easier to administer.

During this portion of the talk, the author will demonstrate the use of WCB in several courses with particular emphasis upon applications in a freshman chemistry course being taught the spring semester of 1999. The corresponding WebCT site will also be demonstrated. The author has found that it is most useful to construct a web page for the course which contains the course syllabus, homework assignments, lecture notes, old tests, and other such information and have links to WCB or WebCT from this web site. It is much easier to do the necessary housekeeping from semester to semester with the items stored on a separate web site rather than to the course supplement. The author's general web site for a freshman chemistry course will be briefly discussed.

Distance Learning with MACS

D. Sturzebecher, O. Brand, M. Zitterbart
Institute of Operating Systems and Computer Networks, Technical University of Braunschweig
Bültenweg 74/75
38106 Braunschweig, Germany
{sturze|brand|zit}@ibr.cs.tu-bs.de

Introduction

Distance learning is a fast developing field with many different aspects to it. One commonly accepted differentiation is between the synchronous and the asynchronous aspects of distance learning. The synchronous aspect refers to learning scenarios such as study groups or class rooms. Asynchronous teaching is mainly represented by exercises (Zitterbart et al. 98). To provide a complete environment for distance learning it is necessary to consider both aspects. Asynchronous learning has been investigated to a great extend and many, mostly WWW based systems have been devised to support it. Synchronous learning in this respect is still less developed. There are a number of systems available, but these do not completely cover the needs of synchronous learning, as many underlying topics are still open to research.

The Modular Advanced Collaboration System (MACS) developed at the Institute of Operating Systems and Computer Networks (IBR) of the Technical University of Braunschweig aims at providing a flexible, scalable and easy to use system for synchronous distance learning. New ways of visualizing interactions among learners and teacher provide network-based learning that is similar to real life scenarios. Asynchronous aspects of distance learning are covered by the WWW-based learning environment Tele online/offline Learning (To/oL) also developed at IBR (IBR 98).

Structure of MACS

MACS offers an open framework for Computer Supported Collaborative Work (CSCW) applications as needed for synchronous distance learning. Due to its modular design, MACS can easily be configured to serve different scenarios, e.g., study groups or class rooms. The study group scenario assumes a small number of participants with equal rights, while the class room scenario provides extended rights to the teacher. Larger scenarios to model other environments, e.g., a conference with hundreds of participants, are thinkable.

MACS consists of three different levels: **network**, **tools** and **control**. At the **network** level the best suited protocol for the chosen scenario can be configured by taking the number of participants, the type of media and the available infrastructure into account. The number of participants is mainly determined by the type of scenario. The type of media involved can result in drastically different requirements (e.g., a text tool/chat vs. high quality audio/video). The infrastructure available to the participants has to be considered, as this might limit the choice of media (tools) and suitable protocol, thereby, limiting session size (i.e., number of participants). The **tool** level contains the main functionality of the available/used tools. A session is created or joined without any tools activated. Once in the session it is up to the learner to start a selection of tools and, thereby, create/join the corresponding media stream. An example for the motivation of not automatically joining all media streams is a mobile participant, who due to the bandwidth limitations of the wireless connection may not be able to support video streams. The **control** level is responsible for system and session administration. The system administration includes the maintenance of databases listing the current sessions, known users and available applications. Mechanisms to create, join, conduct, leave and terminate a session are offered, as well as mechanisms to invite or expel a participant. The session administration and visualization is performed by a session controller. This is necessary, as it is possible to simultaneous participate in more than one session.

Session Control

In MACS session control is performed by a session control module, such as the Visual Session and Floor Control module (ViSCO). ViSCO performs session and floor control in a virtual meeting room, in which participants are represented by thumbnails (Fig. 1). Various state information about the participants is provided through the thumbnail and symbols associated. An example is the participants multimedia (e.g., audio and video) equipment, represented by the symbols above the participants thumbnail. A camera symbol means that the participant has a camera available and can, therefore, source a video stream.

Floor and session control are also performed within the virtual meeting room. If a learner requests the audio floor, a *speaking bubble* is displayed on top of the corresponding thumbnail. This can easily be recognized by the other participants, especially by the current floor holder who may decide to release the floor. This type of visualization of social situation within a session helps participants to interact in a more natural way, just like in a conventional teaching and learning scenario. The graphical representation depends on the learning scenario. For the study group scenario (Fig. 1) the participants are arranged around a simple table, while the class room scenario puts the teacher in front of his class.

The integration of the session control into the virtual room provides a consistent user interface and a strong grouping of control elements. This prevents the well-known problem with complex user interface due to a large number of buttons, sliders and other control elements (e.g., MBone-tools) (Kuma 96).

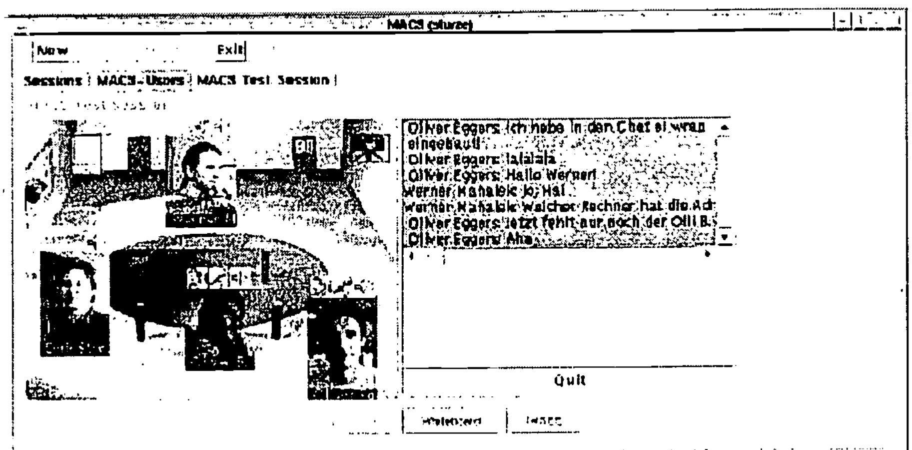

Figure 1: MACS user interface.

Conclusion and Outlook

There are different scenarios in distance learning, each with its own set of requirements. MACS provides a flexible and modular system which can easily be configured to fit the scenarios needs. A strong emphasis is placed on ease of use to help novice learners and teachers to learn the system. Feedback about the current session situation is provided by VISCO, allowing for more natural learning. Further extensions are planned and other scenarios, besides study groups and class rooms will be investigated. For further details please visit the MACS homepage at htttp://macs.ibr.cs.tu-bs.de/.

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Multimedia Cases in Teacher Education: Towards a Constructivist Learning Environment

Ellen van den Berg
University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands
berg@edte.utwente.nl

Introduction

This paper is about the integration of multimedia cases in elementary science teacher education. These cases have been developed within the framework of the MUST-project (MUltimedia in Science & Technology). The MUST-project is a joint venture on behalf of three Teacher Education Colleges, the National Institute for Curriculum Development and the University of Twente in the Netherlands. The project aims at developing multimedia cases for the professional development of prospective teachers in elementary science and technology education. In the first project year two working prototypes on CD-ROM were developed. During this year the MUST-team became increasingly aware of the significance of the implementation of multimedia cases in teacher education programs. This paper ends with the notion of flexibility-in-use that in our opinion is a promising way to reconcile the voice of theory and the voice of practice.

Multimedia cases and a constructivist learning environment

In this section the design of the MUST multimedia cases are described according to principles for the design of constructivist learning environments (cf. Honebein, 1995). This description is not limited to the cases themselves, but, if appropriate, also the broader scope of teacher education programs is taken into account.

Embed learning in a realistic and relevant context

Non-scripted edited video of (an) elementary science lesson(s) forms the core of every MUST-case. These video clips are both a realistic and relevant context for prospective teachers. The clips are edited in a way that they provide ample opportunity for practising analysis and contemplate action (cf. Merseth, 1996). So, they are not meant to follow uncritically. On the contrary they intend to stimulate reflective thought and communication. These activities are also supported by assignments in which prospective teachers are encouraged to analyse the video from different perspectives and use these knowledge constructions in planning and implementing elementary science lessons themselves.

Different perspectives and multiple modes of representation

The MUST CD-ROMS include comments on the lesson by the video-teacher, experts, and prospective teachers. So, students are provided with experiences from different perspectives. However, there is some controversy among specialists in case-based instruction about whether or not to include experts' comments into a case. For instance, Merseth (1996) thinks those comments may inhibit the construction of knowledge by novices. When novices have read what "experts" say about the case, they may tend to abandon or suspend their own beliefs in favor of the "delivered wisdom" (p. 733). On the other hand, Shulman (1992) argues that, for example, experts' comments provide additional perspectives or lenses through which to view the events of the case. So, they add complexity and richness that gloss rather than simplifying or trivializing the events (p. 12).

In the MUST-project the use of multiple modes of representation has been applied in different ways. Firstly, the earlier mentioned edited non-scripted videotapes and audio comments on the video represent science lessons in elementary classrooms in different modes. Moreover, other modes of representation are depicted by all kinds of textual information.

Ownership an voice in the learning process

A third design principle is to warrant ownership and voice in the learning process by prospective teachers. This implies that they are encouraged to reflect on their knowledge construction processes and take responsibility for setting learning goals and pursue learning processes. In the design of the CD-ROMS of the MUST cases this principle has been applied by constructing an open non-linear interface. A second, and more important, way to account for this design principle is to formulate assignments that have an open character and stimulate the users to reflect on their learning processes.

The voice of practise: teacher educators

Especially the four teacher educators in the MUST-team refer repeatedly to the issue, that students are not familiar with working in a constructivist learning environment. The teacher educators question how much responsibility their students may handle. Moreover, they are worried about their role both in terms of their responsibility and in terms of practical implications. The former point may be illustrated by a remark of one of the teacher educators: she stated that it is her responsibility to do her utmost that students will reach the predefined learning objectives, so she wants to implement one of the multimedia cases in a rather traditional setting. This setting consists of a science method course, which is assessed by a uniform test for all students.
The latter point consists of concerns of teacher educators to assign all different types of more open assignments, such as portfolios. Or as one of them formulated it: For time reasons it is simply impossible for me to grade all these assignments.

Conclusions: towards flexibility-in-use

In this paper a dilemma is sketched between the ideal of multimedia cases in a constructivist learning environment and the reality of teachers and students in teacher education programs. In order to overcome this dilemma, the MUST project introduced the notion of flexibility-in-use. This notion implies that, especially, teacher educators have a considerable freedom in the way they want to use the multimedia cases, because from an implementation perspective it is neither possible nor desirable to impose a change in practice on teacher educators. By doing so, we take the warning of Louden and Wallace (1994) seriously. They warn reformers not to fall into the trap of the constructivist paradox. This means that reformers press teachers to make the transformation from conventional to constructivist practise in a single step. We opt for a more realistic reform agenda in which learning to teach with multimedia cases is perceived as a process of gradual reformation and elaboration of teacher educators' established patterns of teaching.

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Enhancing Web-based Materials with Video Clips

Susan Mehringer
Cornell Theory Center
Cornell University
Ithaca, NY USA
susan@tc.cornell.edu

Background: CTC Education and the Virtual Workshop

The Cornell Theory Center (CTC)* began offering asynchronous distance learning over the Web in 1995, with its first offering of the Virtual Workshop. The Virtual Workshop is a Web-based set of modules used to provide distance education in high-performance computing. To date, we have conducted ten Virtual Workshops for about 1000 participants from academia, corporations, and government offices.

A goal in the Virtual Workshop evolution is experimentation with techniques intended to provide more interactive components, as well as options for participants with different learning styles. Features we have added include a glossary, interactive quizzes, personalized navigation via frames, animations, audio-tagged foils, discussion forums and whiteboard conferencing, and a web browser interface to lab exercises.

One interesting new technique we are currently incorporating is the use of video clips. We are working with two types of clips. The first type is screen and audio capture for tool demonstration. The second is using a film clip of a speaker in conjunction with other Web-based materials. The video clips will be used to enhance existing online materials. The clips are intended to improve our online educational materials by making the content more engaging and easier to understand.

Tool Demonstration Video Clip

The tool demonstration video clip is a screen recording, with a speaker voice-over. Previously, our online materials covering use of graphical tools such as a debugger or execution analyzer would use text and screen stills followed by a tutorial which walks the reader through the steps of a simple use of the tool. This is very tedious. We feel that providing a method analogous to looking over the expert's shoulder while s/he explains the steps of using a tool is a faster, more effective introduction.

Design Issues

- Web page composition: This video clip is presented alone in the web browser so that the viewer focuses fully on the screen. The clip will include typing, mouse movement, and menu selection. Too much information or activity on the screen might lose the viewer.
- Video clip length: If the topic cannot be covered in less than the ideal web video length, how should the parts be made available? Our ultimate goal is to provide an index into the video, which will allow the viewer to either jump into the desired part directly, or to view the whole segment in one piece. Other possibilities are to leave it as one long clip, and let the viewer fast forward as desired, or break it up into logical pieces, then play one at the time. In practice, we found that the clip for one topic is short enough that the index is unnecessary at this time.

Additional enhancements we hope to include in the near future include offering several clips on a single topic to cover different scenarios and programming languages, and making supporting material available, such as a text version with relevant hyperlinks.

There are several design options that we have decided not to address at this time, due to tool constraints and development costs. They include slow motion, additional screen highlights, and offering to execute a lab exercise synchronized with the demonstration.

The tool for the clip should be able to stop, start, pause, resume, forward, rewind, and show length and current time through the clip. These are common features that are readily available. Other desirable features include editing and file compression. We are currently using HyperCam from Hyperionics.

Speaker Video Clip

The second type of video clip is a speaker talking for approximately five minutes. Reasons to add this type of clip to our web-based materials include:

1. Give the materials a human look and feel. Most of the people who use our materials never see the developers and consultants; many have never seen Ithaca. Adding a "Welcome to the Virtual Workshop" clip or a clip that introduces Virtual Workshop participants to the consultants would serve to put a face on the materials, and hopefully, to make them more comfortable interacting with us by email or chat room.
2. Help in understanding a difficult concept. Supplementing words and pictures with an expert speaker might provide additional help for difficult points.
3. Break up the monotony. Although the materials have interactive elements, such as animations, diagrams, quizzes, simulation programs, and lab exercises, they can still benefit from an interlude of this type.

Design Issues

- Web page layout has almost unlimited possibilities. In contrast with the tool demonstration clip, a speaker clip should be paired with other activity on the screen. One possible usage would be to show the speaker next to the html page, with the html page keyed to advance at the proper time in the video. This picture most closely simulates a live lecture, and has enough activity to keep the viewer's attention. Early efforts may concentrate on having a content expert introduce a new topic.
- Length is also at issue for this type of clip. If the topic cannot be covered in less than the ideal web video length, we will again pursue an indexing solution.

As with the tool demonstration clip, the tool used for the speaker clip should be able to stop, start, pause, resume, forward, rewind, and show length and current time through the clip. We will also need encoding, to pair the video with html pages, and acceptable file size. We plan to experiment with a method to highlight portions of the screen at the appropriate time, used sparingly to focus attention, but not to the point of annoyance. We are currently experimenting with RealPlayer from RealNetworks, which appears to have the best combination of availability to our workshop participants and desired features.

Production and Evaluation Plan

We are continuing to research design issues and prototyping. We expect to evaluate both types of clips in production workshops in 1999. Evaluation will include questions on whether the layout is both clear and aesthetically pleasing, if the use of video clips enhance understanding, and if it is clear how to use and navigate the page. Early responses show that over 75% of respondents feel that the tool demonstration clips would enhance the materials, but less than half feel that speaker clips would be helpful.

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The Electronic Portfolio for the Professional Educator

Dr. Colleen A. Finegan, Associate Professor
Teacher Education Department
Wright State University
Dayton, OH, USA
Cfinegan@wright.edu

Dr. Ronald G. Helms, Associate Professor
Teacher Education Department
Wright State University
Dayton, OH, USA
Rhelms@wright.edu

The three legs of the stool: Teaching, Scholarship and Service remain the three-pronged pitchfork by which professors are raised high to receive promotion and tenure or pitched out of the barn and sent on their way to find another position. Historically, scholarship has been judged by the number and quality of publications and the level of prestige of the journal. Service, the weakest of the legs of the stool, is measured in terms of dedication to thankless positions on committees or in furthering other university goals. Recently, partnerships with school systems and community organizations has been a goal of many universities seeking financial support from federal and state grants which emphasize collaborative partnerships between universities and business or community and human service organizations.

In the past, and even today, the quality and quantity of scholarship and service can be estimated, to some extent, by a paper trail, including books, journals, and a well designed vita. But, how can teaching be evaluated? For too long, end of the term student evaluations have been the major source for judging the quality and effectiveness of teaching in higher education. As many professors and administrators realize, this form of evaluation, administered near the end of the quarter or semester, is often reduced to a popularity contest. Year after year, merit pay and promotion and tenure decisions are often based to a great extent, on these popularity polls. Short of video taping professors in interaction with students, there seems to be few alternative methods to document and subsequently evaluate teaching effectiveness.

For several years, authentic assessment has become an increasing priority in the field of education for teachers, administrators, and curriculum developers. There are many models available for use with K-16 students. Children in preschool and primary grades make judgments with the help of their parents and teachers to choose their best work and place it in a folder or expanding file. Students in the middle and upper grades may continue this method and may take pictures of their projects to place in their growing portfolios. With increased availability of computers in the schools, students in third and fourth grade may begin to use simple multi-media software to document their best work and projects. Goodlad, Comer and other proponents of educational reform recommend that schools and colleges of education provide future educators with multiple experiences in classroom settings beginning early in their educational careers. This proposal further emphases the need for authentic assessment as professors attempt to evaluate the pre-service teacher's growing levels of expertise in the educational process. Whether the decision is to develop a paper or an electronic model, the concept of portfolio development is a solid one.

The College of Education and Human Services (CEHS) of Wright State University has been recognized nationally as a leader in teacher education. A primary concern CEHS is that pre-service teachers develop skills of authentic assessment to document their own professional growth and, in turn, be able to apply in their classrooms in the future. CEHS has, for several years, assisted pre-service teachers to develop hard copy portfolios. These portfolios are constructed during the foundation portion of the education program, added to during the methods and materials classes and groomed during the student teaching experience. More recently, the authors have offered pre-service instruction in developing electronic models of professional and teaching portfolios, including CD ROM format and web page format.

For the pre-service teacher to the president of a university, the professional teaching portfolio is becoming an integral part of the educator's professional files,. A professional portfolio could be constructed to document all three areas: scholarship, service, and teaching, or any one of the three in isolation. Professional portfolios may be constructed in several ways, but to be used for authentic assessment, the portfolio must be more than a scrapbook, containing stubs from movies or basketball games. An educator could begin with a hard copy and easily develop this into a CD-ROM by simply scanning the documents and pressing them on a CD-ROM. Modern technological advances allow for use of multi-media to enhance the format. For example, a simple portfolio could be constructed using commercial software packages, such as Scholastic's Electronic Portfolios or the Grady Profile. Indeed, any multimedia presentation software may be used to develop a template for student portfolios. Multimedia programs such as Hyperstudio, Astound, Podium, Chisel or Powerpoint could be used to develop a portfolio which might include actual video and audio footage. This addition would provide a glimpse of the educator in the classroom or in individual interaction with students. Many books, as well as the World Wide Web itself may be utilized as models in for the development of a portfolio. The resulting document might then be stored and, in turn, viewed from a CD ROM or disk. One disadvantage with a CD-ROM is that it does take special equipment to press and it cannot be readily updated. Current technology, however, does provide for re-writable CD-ROMS.

A web page may allow for the greatest flexibility in creation, storage, updating and presentation. In the past, web design through programming and required knowledge of html limited the widespread use of the web page as a professional portfolio. Now that programs can be downloaded from the web and software purchased at a modest price, web authoring has been simplified and made understandable to a larger population. A web search engine will identify a number of on-line tools which would assist the user in webpage development. Some World Wide Web sites have been dedicated to housing references on web authoring such as:

... WWW Authoring Information (http://www.netspace.org/users/dwb/www-authoring.html)
... The Virtual Library of WWW Development (http://www.stars.com/Vlib/)
... Educators familiar with Clarisworks will adapt easily to Claris Homepage.
... Current versions of Pagemill offer the novice a path to webpage production.

More flexible, but advanced programs might include:

... Lotus eSuite DevPack (http://esuite.lotus.com/preview/preview.nsf/Content/Home+Page)
... GoLive CyberStudio 3.0 (http://www.golive.com/three/gogetit/index.ehtml)
... Virtual Media Technology's /) Virtual Media Publishing Suite which includes HDK3, INTRAWEB, Web*lite, and Hypershelf 3.0.(http://www.virtualmedia.com.au)
... Matterform Media - HTML Grinder and Theseus(http://www.matterform.com/design/)
... E-Publish (http://www.stattech.com.au/)

Educators may design their portfolios to document items included on their curriculum vita in the areas of scholarship, teaching, and service. In the area of scholarship, text files with grants received, and proposals which have been accepted for presentation at professional conferences might be included on the web page. Educators might provide hypertext links to their articles published in journals or to the professional organization's web page announcing a annual conference at which they are presenting a paper. In the area of teaching, examples of assignments and projects might be included as a hypertext file or as a scanned photo with sound bytes allowing the students to talk about their projects. Students' individual web pages might be accessible through a professional portfolio of their professor, documenting the student's professional growth even after graduating. Service could be documented on a professional educator's webpage by providing links to community resources and information on local events. Again, text files of grants which involved partnership schools and other community agencies could be included. Letters of appreciation from students and others might be collected and stored in an electronic portfolio format. The choices of what might be included in the portfolio are limited only by the creativity of the educational professional and the knowledge of the software available to make it happen. As an exemplar of authentic assessment, the professional educator's electronic portfolio may become a template used to document individual and professional growth in the business world.

Hematology Web: Supporting the Transition from a Disciplinary Medical Curriculum to an Integrated, Application-Driven Curriculum

Douglas Mann, Ph.D., Ohio University College of Osteopathic Medicine, USA, mannd@ohio.edu

Scott Jenkinson, D.O., Ohio University College of Osteopathic Medicine, USA, jenkinson@exchange.oucom.ohiou.edu

Andrea DeMott, M.A., Ohio University College of Osteopathic Medicine, USA, demotta@ohio.edu

Dan Johnson, M.A., Ohio University College of Osteopathic Medicine, USA, djohnson1@ohiou.edu

Ann Kovalchick, Ph.D., Ohio University Center for Innovation in Technology for Learning, USA, annk@ohio.edu

Introduction

Many medical school curricula have been reorganized in the past 20 years to incorporate problem-based, application-driven learning (Norman & Schmidt, 1992). Similarly, several MBA programs have been developed with projects rather than separate disciplinary courses as the primary learning activity (e.g., Stinson et al., 1998). However, faculty at any level of education may fear that a curriculum organized around problems or projects will not provide an adequate grounding in the individual scholarly disciplines that are the basis of course sequences in a traditional curriculum. Providing students with access to interactive web-based disciplinary resources (chosen or developed by faculty) for independent study and as a problem solving resource is one way to address faculty concerns about disciplinary coherence in an application-driven curriculum.

In medical education, the recently-developed "clinical presentation" approach to organizing curriculum content capitalizes on the motivational value of problem-based learning while providing a framework for learning based on an expert's organization of the knowledge (Mandin, Harasym, Eagle, & Watanabe, 1995; Mandin, Jones, Woloschuk, & Harasym, 1997). The clinical presentation approach provides students with a concept map for each of a series of common problems (e.g., anemia, chest pain, difficulty swallowing, fever) that shows how an expert's knowledge is organized, linking basic causal mechanisms and disciplinary concepts to specific diagnostic categories in a problem-specific manner (for an example, see Dane, 1997). Knowledge learned in this framework does not have to be reorganized in order to be applied. When the causes of a problem are learned in logical groupings that help learners to distinguish among the causes, diagnostic judgments are improved (Klayman & Brown, 1993).

The Ohio University College of Osteopathic Medicine (OU-COM) is reorganizing its traditional disciplinary curriculum into a Clinical Presentation Continuum (CPC) for implementation in Fall of 1999 for first-year medical students.

Project Goals and Design

The general goal of the Hematology Web project is to provide a complete online medical hematology course outline with slides that can be used 1) in a disciplinary curriculum for large-group presentations or independent study, and 2) in a new integrated curriculum via links to application topics. Hematology Web should deliver images of medical quality usable on a low-bandwidth connection, and the user interface should support comparison and contrast of any two images from the entire project.

Hematology Web's user interface was designed to emulate the menubar and pull-down menus of a standard computer program in order to make efficient use of screen space and to provide consistent, simple navigation. Two pull-down menus support navigation between and within topics. The 16 course topic titles are always available in one menu, and the web page anchors for the currently-selected topic appear in a second pull-down menu.

Images in Hematology Web are available in three resolutions: thumbnail, medium, and large (600 x 400 pixels). Space on the right side of the screen is reserved for two medium-sized image windows. After two images have been loaded, the next requested image replaces the "older" of the two current medium-sized images. This design makes it relatively simple to compare and contrast any two images in Hematology Web. Clicking on a medium image loads the large version of the image in a new centered browser window.

For independent study, the thumbnails are embedded in context in each topic's textual outline. For presentations, a slide list at the end of each topic contains just the image names and thumbnails with no other text.

The user interface was created with Javascript and frames. Javascript programming manages the pull-down menus and the loading and sequencing of images and labels in the image frames.

Eighty second-year medical students using Hematology Web as a course supplement in Fall 1998 were surveyed concerning user satisfaction and suggested improvements pertaining to use of the program in large-group, computer lab, and home settings.

Hematology Web has met its design goal of providing a user-friendly presentation and independent-study program for the content of an entire medical school course for a conventional or application-driven curriculum.

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Learning Among Individual Members In Cross-Functional Teams In New Product Development: A Case Study

Gita Varagoor
Medical Educator, University of Texas-Houston Medical School
Houston, Texas, USA
email: gvaragoo@dean.med.uth.tmc.edu

Sara McNeil
Assistant Professor, Instructional Technology Program
College of Education, University of Houston
Houston, Texas, USA
email: smcneil@uh.edu

Introduction

The purpose of the research study was to observe the application of learning theories to cross-functional teams in new product development and how individuals acquired skills and competencies as a result of their collaboration. A cross-functional team consists of individuals with specific but different skills, who work together toward a common goal, have a common purpose and follow a common approach (Katzenbach, 1993). For purposes of this study, skills were defined as those relating to design and development. Competencies were defined as the ability of the team members to communicate effectively, their perceptions of working in a collaborative environment and their level of confidence. The new product development process referred to the process of designing and developing an innovative product for the market.

Theoretical Framework

The theories of learning and cognition included in the study were cooperative learning, collaborative learning and situated cognition. Cooperative learning is an instructional strategy which proposed that when learners are teamed up for attaining a common goal, their cognitive learning gets enhanced (Slavin, 1991). Collaborative learning is a learning process where the team members through interacting with one another define the learning process (Bruffee, 1993). Situated learning is a theory dealing with the acquisition of knowledge in a given context. (Brown, Collins & Duguid, 1989).

Method of Inquiry

The research study was conducted using the naturalistic research design (Guba & Lincoln, 1985). In naturalistic research, the researcher assumes that it is difficult to understand any phenomenon outside its context. This research design was chosen because it would offer a rich understanding of the process of learning of individuals involved in the new product development process.

Participants

The participants for the research study consisted of 18 team members of cross-functional teams working in software; hardware and telecommunications related companies. Out of the 18 participants, 12 were core team leaders and decision-makers.

The Instrument

The instrument for the research study consisted of a researcher-developed questionnaire with open-ended questions. After each interview was transcribed, case studies were prepared.

Results

Most of the team members expressed the view that the collaborative environment offered them a window into the product development process as a whole and not just their part. The team members who were software engineers were able to understand the marketing aspect of the product development since in most cases the market defined the specifications for the new product under construction. The team members were usually brought forth skills for their particular area of expertise but often times had to learn new skills during the course of the project as and when the need arose. These skills, like design and development skills, were learned in collaboration with their peers. Team meetings were considered crucial since in some cases it became a platform for getting feedback from one's peers on the work done. These team meetings then became a learning board for the team members. It was deemed important to leave the lines of communication open at all times. Once the team members felt that their opinions counted they had a sense of ownership towards the project and attitudes changed for the better.

One aspect that came up time and time again was the fact that cross-functional teams were the way to go in today's market. The products were complex and the time frame short, which made it imperative that a cross-functional team be put together for meeting the deadline for the product. Also it was felt that no single person possessed all the skills needed and hence the need for a team of people with specific skills.

Importance of the Study

The study leads one to believe that there is a need for cross-functional teams in any product development because no single person could provide all the necessary skills needed. The study leads one to wonder if successful collaboration is due to good facilitation or due to the team selection process or due to the projects being challenging. It also leads to the question of whether we need more cross-functional teamwork among the faculty in the field of education. And if so, how will the design and development of curriculum be and how will this affect the delivery of instruction. Finally, in the area of Instructional Technology, collaboration of skilled people from different content areas will result in the creation of innovative multimedia instructional materials. With the rapid growth of the World wide-web, it becomes imperative to study the impact of collaboration among learners spread in different parts of the world. How will this impact classroom teaching and learning remains to be seen. What adjustments will be made to the existing classroom structures in order to deliver the instructional materials in an effective manner remains to be seen.

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Development and Evaluation Design of Physics Learning Modules within the Lilienthal Web-Based Theoretical Flighttraining

Rolf Zajonc and Prof. Dr. Lutz Schön
Didaktik der Physik, Humboldt-Universität zu Berlin
Invalidenstr. 110, 10115 Berlin; Germany
zajonc@physik.hu-berlin.de

Introduction

The Lilienthal project arose due to both the emerging interest of several European pilot schools for computer aided learning and the decision of the European Community to foster European educational multimedia applications.

Apart from six pilot schools[1] three universities and the Fraunhofer Institut für Arbeitswissenschaft und Organisation participate in Lilienthal. The latter and the University of Stuttgart do the project management. The other two universities advice with their theoretical background the development of the "Virtual European Pilot School" and care for the research. Hereby the University of Amsterdam is responsible for socio-economic concerns whereas the Institut für Didaktik der Physik of the Humboldt-Universität zu Berlin focuses on pedagogical aspects. Lilienthal started '98 and will last for two years including demonstration and evaluation. A pilot study will be carried out in March '99 and it is foreseen to present its results at this conference.

Lilienthal

A complete pilot training takes about two years and involves several examinations with differences between the different nations. The whole training requires about 750 hours of instruction and some hundred hours of flight training. The Private Pilot License (PPL) as the base of all other licenses, is handled with up to 100 hours of instruction and approx. 40 hours of flight training. This varies from nation to nation. The participating pilot schools in this project develop an European-wide accepted instruction material focusing on the approx. 100 hours of PPL-Instruction to reach the open European market of private pilots. This instruction material is basically developed as an computer-mediated system not only in order to make didactic use of the new technical possibilities but also in order to reduce the costs for the students as well as for the often recently privatised schools. This system will finally result in an internet based Distance Learning Platform (DLP). It offers HTML-pages as well as multimedia CBT lessons, which can be run through and discussed asynchronously (Newsgroups, email) or synchronously (Electronic Classroom containing audio conference).

The Course

Sense-Giving-Structure SGS is a term used within Lilienthal for the idea to build the PPL course not subject divided but in interrelated stages, which partly run parallel to the practical instruction. Currently the number of subjects that are taught for the PPL varies from pilot school to pilot school but this number is adjusted to the nine subjects of the general European-wide requirements defined be the Joint Aviation Authorities (JAA). These are foreseen to be integrated into the national laws. If you write the 9 subjects like Navigation or Meteorology into 9 columns and 8 stages of the practical instruction like First Touch or First Flight in 8 rows a matrix emerges. Into this matrix were provisionally placed the 108 topic titles suggested by the JAA. Corresponding learning objectives were formulated. These were discussed in a Delphi-process [Dalkey&Helmer 1963] and finally led to an European Curriculum based on agreed detailed learning objectives.

The two-dimensional structure takes the opportunity not to be restricted to a weekly timetable any more. The student finds himself in semi-organised environment, represented by the matrix-structure. He is free to follow links within the subject, to a Basics course about the science behind some phenomenon or to external links for additional information.

[1] Lufthansa Flight Training, Ecole de Pilotage Amaury de la Grange Societe Anonyme (with two subcontractor schools), KLM Luchtvaartschool B.V. and Horizon Swiss Flight Academy Ltd.

The Knots in Hypermedia Environment

For the SGS in addition to the subject matter experts stage responsibles were determined who crosscheck the learning objectives for possible strong relations and intersections. These central points match in particular the possibility of hypermedia: *"The idea converted in hypertext is to organise a topic's content in single information units and to electronically represent these in a network database in form of knots and links between knots."* [Tergan 95, translation]. Research will focus on the way students work with these knots. In Lilienthal most have a scientific content like the concept pressure. The student will meet the term pressure at various occasions during his way through the course. The expectation is that the medial representation of multidirectional knots assist the linking of knowledge. A hint for this assumption could be drawn from mc-tests with three different groups of students. The first group will meet these Science Modules via links from the SGS as described, while the second will be given the modules as precourse and the third will be taught in traditional classroom teaching. The test will enumerate topics and ask for subjects which contain these topics.

Learning Modules

All modules will have three levels. The student will always enter a module on the "mandatory" level. This starting page is an overview about the linear sequence of "recommended" learning steps. By using optional links (the links are marked according to their level) the student can enter the "nice to know" level. This might be an external homepage, an historic anecdote, a discussion group. The "nice to know" level shall serve as the *"motivating narrative element"* [Waraich 98]. If its pages assist the learning process is open for investigation.

Links

The important difference between learning in a hypermedia environment and traditional learning with a book or in a classroom is the easy and comfortable use of links. *"There has been insufficient time for the field to formulate a detailed theory of learning from such systems"* [Shapiro 1998] Hence explorative investigations of the new medium's possible advantages are needed to increase our understanding hypermedia learning. In Lilienthal research will focus on the assumption that students look up something they already met before but feel uncertain about more often when they use the comfortable and direct link to the corresponding information. It is to prove whether this assumption is true and if so whether this really leads to a safe basic knowledge.

Evaluation Design

The evaluation methods will be threefold: questionaires, tests and protocols. Questionnaires are needed to receive the students' impression of the learning modules and their personal opinion about their learning progress. It will be based on the questionnaire used by the EuroMET-Goup for the user evaluation results [Phelps and Reynold 1998]. Pre- and posttests are carried out in order to measure the learning progress. Of course there is no guarantee though, that individual gain of knowledge origins from the corresponding learning module, when students can interfere with all kinds of information sources for a period of 3 months. Hence the learning success must be related to the learning paths through the whole course. With individual learning protocols hypermedia offers a unique opportunity to recheck the students actual use of the learning media.

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Designing Instruction for the WWW: A Model

Gayle V. Davidson-Shivers, Ph.D.
Behavioral Studies and Educational Technology
University of South Alabama
Mobile, AL 36688
gdavidso@jaguar1.usouthal.edu

Karen L. Rasmussen, Ph.D.
Professional Studies and Technology
University of West Florida
Pensacola, FL 32514
krasmuss@uwf.edu

Introduction

Web-based instruction (WBI) is an emerging delivery system used by public school systems, postsecondary institutions, military training centers, and business and industry to provide learners with education and training opportunities. There are literally millions of web sites on the Internet which use a variety of themes on almost every topic from antiques (http://www.antiquesonbroadway.com/) to zoos http:/www.zooatlanta.org/), providing global users with a wealth of information on almost any topic. In the great majority of cases, these sites are designed for information sharing rather than for instruction. Today, educators use the web for a wide variety of education and training purposes such as having students locate sites to gain information about instructional-related topics (Ackerman, 1996; Garner & Gilingham, 1996; Kehoe & Mixon, 1997; Reddick & King, 1996). Others have used the web for sharing information through listservs, newsgroups, chat rooms, MOOS, MUDs, etc.

WWW & Instructional Design

To harness the WWW for instruction rather than just gathering information, web-based learning environments must be created following principles of instructional design. Models such as the ADDIE model, as well as other traditional design models, follow a fairly linear path to the design and development of instruction. When developing instruction for the WWW, alternative views of design and development must be employed, taking into consideration the unique capabilities and characteristics of the web.

A critical component of successful instruction delivered through the WWW involves the active engagement and promotion of interactivity in the learning environment. Instruction that provides for active engagement depends on a careful plan that integrates strategies that attend to various learner characteristics and WWW features. This precisely planned instruction leads to the design and selection of appropriate performance objectives, instructional strategies, and technologies (even with selecting the WWW as the medium, there are other media selection considerations) for the delivery of the instruction. This integrated approach to analysis and design ensures that the development of the resulting instruction meets the desired goals, or purposes of the lesson.

Emerging technologies such as the WWW can be used to facilitate and promote learning in web-based environments. Learning is promoted through the use of instructional strategies which, in turn, provide a framework for presenting instructional materials. The learning environment is defined by the boundaries of an instructional situation – class session, part of a course, or an entire program or course of study. The integration of a variety of instructional strategies within a learning environment facilitates the successful learner. It is critical for designers to remember that these technologies serve as our tools that help students learn and instructors teach. The designer's skills and creativity, as well as capabilities of the delivery systems being accessed, are the only limits on how these technologies can be used in the development of instruction.

There are a plethora of instructional design and development models within the Instructional Design and Development field. Typically they cover from the point of design (micro level) to those that look at the entire process (macro level). Andrews and Goodson (1980) conducted an analysis of the basic models and described specific attributes of characteristics of over 60 models. Since that time, other design models have been revised (Dick & Carey, 1995) and new ones have been developed (Smith & Ragan, 1994). Commonalties among models in terms of elements revolve around the notion that they are systematic in process, have several stages of design, development, and evaluation, and have an initial stage of analyzing goals, learners, and context.

Web-Based Instructional Design Model

Web-Based Instructional Design (WBID) contains the basic stages of analysis, design, development, implementation, and evaluation that are also found in other models. However, the arrangement, or structure, of these stages is less linear than in some of its predecessors. The design and development process using the WBID model is an iterative and ever-changing and evolving process. The WBID model begins with an analysis stage, moves to a combined design/development stage, followed by the implementation stage. What makes WBID unique is that once the analysis stage is completed, the evaluation stage also begins. Evaluation is continuous through the design and development stage and is carried through the implementation stage. Because evaluation is such an important element when designing effective instruction and learning environments, it must be planned and conducted throughout the product design and development stages.

Each stage of the model contains and culminates in decision points, action plans, or products, so that the shift from one stage into another and back again is relatively seamless. This seamless shift is especially seen in the design-development stage where prototypic materials and products are developed initially before moving into production of a finished product.

This model is a natural way for instructional designers develop materials for learning as well as providing a constant refinement and enhancement of the product based on thc evaluation information. Evaluation, then, is no longer viewed as an add-on or tail-end stage, but an integral part of the design and development process. While most designers say that they conduct periodic reviews of materials and formative evaluation, they may not make it as integrated as our model suggests.

Conclusion

The World Wide Web offers many challenges and opportunities to those who design and develop web-based instruction. Traditional models of instructional design do not meet the needs of designers who are designing instruction for this emerging technology. The WBID Model facilitates the design of web-based instruction.

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The Pedanet Project
Implementation of Schoolnet in Central Finland - Tools and Contents

pentti.pirhonen@jamsa.fi
valijarv@piaget.jyu.fi

Introduction

Pedanet Project:

1. Supports schoolbased projects
2. Developes web based services for schools
3. Implements more advanced telecommunication infrastructure for schools in Central Finland
4. Implements the Peda.net Schoolnet in Central Finland

Pedanet is a R&D project for utilizing the opportunities of modern information technology in learning and communication as a part of the operation of educational institutions. The target of Pedanet is to contribute to all the educational institutions and the municipalities in Central Finland by setting up, and advancing the performance, compatibility and economy of their telecommunication networks.

The essential objectives of the Pedanet project are:
1. To activate and to support the schools in the planning, development, and implementation of their own projects.
2. To promote equal access to information technologies in all schools regardless of current levels of resources and community support. Our primary concern is giving small schools the same opportunities currently available to larger schools. Through the schools, we reach out to include the community as a whole through continuing education and the provision of public access workstations.
3. To evaluate the use of data networks in the schools; and evaluate co-operation between schools.

Goals and Methods

The goal of the project is to build, by the end of the year 1999, an integrated, user-friendly, and pedagogically enriched electronic network for the use of all the nearly 60 000 students and 300 schools operating in the region of Central Finland.

The Pedanet project supports the development projects of the educational institutions in helping them create their own innovative ways of utilizing telecommunication networks in teaching and learning. Teachers are offered opportunities to disengage from the daily teaching work for a certain period to work in their own Pedanet-related projects. All projects include research activities that connect the projects to international discussions about the utilization of information networks for pedagogical purposes.

The purpose of Pedanet is not to externally guide the school's activities in their own development work but to support and advance the implementation of these projects through training, evaluation, research work and resourcing by offering pedagogic and technical expertise in form of various information network services.

How Pedanet supports school based projects

Finds experts
We locate experts in the use of information technology in each region. These experts try to identify potential projects that would be valuable to communities in their region.
Starts projects

Ten pilot projects were selected for Pedanet support. These projects may be specific to a region or may cover all of Central Finland. Projects subjects include: teaching methods, teaching contents, materials, and processes that have the potential to reform pedagogical practices in the schools involved.

Supports project development and disseminates project achievements to others

Pedanet facilitates contact between project participants and experts that may provide them assistance. We provide teachers with release time so that they may concentrate on their projects. We also provide project participants software and other technological support for instance establishing small services for schools on Internet.

When projects near completion, we will publish the results on the web and sponsor conferences to share what project participants have accomplished: their successes, the problems they encountered, and anything they have learned as a result of participation in their projects.

Tools and Contents of Peda.net Service

Origo, the Heart of Peda.net Service and the Main Tool for Virtual School in Central Finland

All the 300 schools in Central Finland will have an access to Peda.net Origo.

The Peda.net Origo is developed by The Future Learning Environment (FLE) project, coordinated by Medialaboratory / University of Art and Design, Helsinki, University of Helsinki and Sonera Ltd.

Origo includes modules for learning with new technology. These modules are called FLE-tools. (The working title). The FLE-tools are designed to help the students engage in productive work with knowledge objects and artefacts and generate new objects and designs. FLE-Tools is a groupware system designed for supporting collaborative knowledge building over the Internet. FLE-tools consist of several modules that are designed to facilitate collaborative knowledge building through a constructive process.

The Webtop; The environment provides each user with a personal open 'Desktop' in the web ('webtop'). The webtop is used to store digital materials and to share them with other students.

The Discussion Module is a shared space for discussing topics and concepts generated by the users.

The Jam Session module is a space for the collaborative construction of digital artifacts.

The Library is an adaptive medium to publish and browse multimedia learning materials.

Other Peda.net Tools and Services:

Interactive OnLine Magazine

A tool for pupils to publish shared web Magazines online.

Net Publishing system for schools

A tool for schools to publish information and notices on Web

"CUR-PRO" CURriculum PROcessor

Internet accessible application for Curriculum development

Document conferencing service

Voice Chat - Text Chat applications, internal IRC server
Mailing lists, Open Discussion forums, Thematic Discussion forums
Notice Boards, Web Calandars
Pedanet Commercial – E-Shop for schools
Information and News service for schools

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PROFESSIONAL DEVELOPMENT GOES ONLINE: ITÕS ABOUT TIME

Angie Parker
Educational Technology
Gonzaga University
U.S.A.
aparker@soe.gonzaga.edu

Introduction

Its about time professional development is seen as something other than teachers sitting in a stuffy room, drinking cool coffee from styrofoam cups and listening to a speaker who may or may not be an expert. Furthermore, instruction online and instruction Òon-demandÓ is about time - time that teachers have in small segments before and after school and during preparation periods. And finally, the nation has entered the Information Age, itÕs about time professional development joins the revolution and participates in the move from physical space to cyberspace for the continued training of its teachers.

Rethinking Professional Development

With ever shrinking budgets, schools and school districts are no longer able to provide quality professional development in the traditional manner. With budgetary constraints in mind, many people are realizing that professional development must be delivered differently and must be constructed differently.

In addition to changes in delivery, professional development requires revisions in the way it is constructed. First, professional development in the Information Age must include a wide array of learning opportunities that encourage active participation in experiencing, creating, and solving real problems (Jakson, 1997). Second, professional development must not only be available to teachers 24 hours per day, seven days per week, but must take into consideration the audience of learners created by those teachers. Finally, professional development must provide the opportunity for teachers to reflect critically on the material and to fashion new knowledge and beliefs about the content, the pedagogy, and the application in the classroom.

Moving inservice training from stuffy rooms to the endless expanses of cyberspace allows all three criteria for revision to be accomplished and for professional development to be delivered into the hands of the Information Age. The following article will present not only an overview of a professional development project, entitled *Excellence thru Linkages*, but also illustrate how the professional development was re-constructed.

First a Brief Overview

Excellence thru Linkages was a two year, funded project designed to deliver technology inservice training to a Native American school in the northwestern United States. The first year of the project involved traditional training and focused on the hardware and software available at the school. Although instruction and discussion both included the integration of technology into the classroom curriculum, little or no evidence of computer usage existed at the end of the first year.

An overview of the project and integration of critical reflection

Forced by the inclimate weather of the winters in the northwest, a team of professors and graduate students developed the idea for online training. Part I of the venture had been offered in a traditional format and had given the faculty at the Native American school the opportunity to become computer literate. Although the technology was readily available and they had the basic knowledge, none were using computers in their classrooms. Part II was, therefore, developed to maximize the synthesis of technology with the current curriculum. Nineteen teachers and three administrators participated in *Excellence thru Linkages*. The material presented was divided into three modules:

* integrated software
* research and,
* presentation.

In the first module, integrated software, teachers were instructed on how to utilize word processing, database and spreadsheet as classroom tools. Activities, applicable to numerous subject areas and grade levels were suggested as were Internet sites for lesson plans using integrated software. Teachers were given three weeks to review the online material and to try one of the activities with their students, and to reflect on the results through the use of an online journal. The online journal was a critical component in this project, as the process of reflection and writing created a stimulus for teachers to better understand their own fears and motivations for teaching with technology. When attempted lessons did not result in the expected outcome, the journal again allowed for reflection. At the end of the three weeks, a required chat encouraged teachers to share their successes and failures and to communicate ideas of how this software package could be utilized in the classroom. Teachers were also required to submit no less than two ideas for using integrated software at their grade level.

The second module, research, provided information for use of the Internet as a classroom tool. Again, teachers were given three weeks to visit the sites offered in the online professional development and evaluate the activities with their students. The chat again encouraged sharing of ideas. Mandatory activities and lesson plans were not required by the administration during the research module, as teachers were becoming more self-motivated and willingly posted ideas to the listserv.

The third and final module, presentation, reviewed the use of PowerPoint, Hyperstudio and Digital Chisel as classroom presentation tools. The same time line and format was again used. This time teachers and their students posted the results of their integration of the software. PowerPoint and Hyperstudio presentations were uploaded to the webpage that hosted the online professional development.

Summary

While the project had many positive outcomes, the world of online professional development still has numerous hills and valleys to traverse before becoming the ultimate answer for continued teacher training. This project allowed for the reconstruction of teacher training and the launch of that training into the Information Age. *Excellence thru Linkages* has only touched on the possibilities of what is to come as the Internet and modern technology combine in the world of education.

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Interactive Net Learning – a Matter of Facilitation

Ulric Björck

Henrik Hansson

The Viktoria Institute, Göteborg, Sweden
ulric.bjorck@ped.gu.se & hh@handels.gu.se

Background

At the University of Gothenburg we have for two years been working with a particular course curriculum as a "stomping ground" for developing net related pedagogics. The courses in Social economy have Problem Based Learning (PBL) as a pedagogical approach and the courses are built upon the use of computer mediated communication in distance education. The PBL approach is described by the CLEA[1] management as a structured model in which a number of necessary steps will be used. A number of cases are the starting point for the PBL process. The case is presented through a vignette that might be presented as a picture, a saying or a description of a situation and it will be of relevance to the aim of the course. The students in the course will then build the case around the starting point depending upon what they have found to be interesting in the presentation. In addition to the introductory presentation, a number of relevant terms will be supplied, which will mark out and enforce the character of the particular case. The idea is that the students, working in dedicated groups, will seek knowledge on their own from different sources.

The evolution of the course has led to a new entirely net-based application called Workspace, we will return to the thoughts behind the creation of this below.

Method

In all and together we have covered most aspects of this course, enabling us to give "thick descriptions" of the processes at hand. This paper merely presents an overview of the rich material that has not yet been fully analyzed. The students answered an electronic questionnaire on the web. The questionnaire dealt with questions about the students' background as well as how the start of the course turned out and what problems the course had at that moment. Both individual interviews of students and a group interview of the supervisors have been carried out. The individual interviews have been structured out of a questionnaire to the respondent. In the interview situation the questionnaire has been used as a support for the interviewer, not as a fixed agenda. The overall aim has been to let the respondent talk freely as much as possible. Almost all of the supervisors were present at the group interview as well as the system administrator. Kvale (1996) finds that the interaction among interview subjects in a group interview often leads to spontaneous statements about the topic being discussed, but that group interviews "generally require that the interviewer has a good grasp of the interview topic" (p. 101).

The interviews have been carried out from May 1997 to May 1998. So far, this work has resulted in 31 interviews with students (out of 50 students), and the additional interview with the supervisors. Most of the interviews have been written down in order to improve the quality of the analysis (compare Palmer, 1969).

Results

Results from the questionnaire showed that the students experienced the course as time consuming and the students had also problems in finding literature to solve the tasks/cases given to them. The

[1] CLEA was the name of the European Union project that produced the original courses.

questionnaire also showed that some students had left the course. The teachers each had a different approach to working with the students on the net. However, the main common role for the teachers is that of facilitation. This enhanced the learning process of the students as the teacher, who became the "facilitator", acted merely with a supporting role based on what he knew about the learning process - this rather than taking part of the specific learning process discussing subject matters. In participating in the course the teacher learnt a lot as well as the students, something that we find to have a lot in common to the discussion about symbolic interactions (Blumer, 1962).

One of the facilitators chose to further his experiences from this course together with the technician of the course and developed a new computer application called Workspace. The advantages of this can be summarized in the sense that Workspace does not reproduce the classroom in the way that the used software WEST did. It also has many more possibilities to create discussion groups and to search for information in these through an engine for statistics as well as content. Workspace is built with PBL in mind and is therefore fully developed for the encounters that PBL can create.

Discussion

A description of the development process, from the perspective of how the students experience their learning situation connected to the learning of the teacher, is the primary target of this section. This perspective is imperative to the continuous process of building and maintaining the group of students that emanates (Husserl, 1960) out of the understructure of the student body. This understructure is enhanced by the process of role taking (Mead, 1934) over the net, which has somewhat different preconditions to the role taking or socialization (Berger, 1967) of a student in an ordinary course. The mere knowledge of these mechanisms is a precondition to facilitate this process. For indeed it is facilitation rather than teaching or supervising. The "facilitator" rather than the teacher has not restricted the students' learning process and therefore both the learning process and the subject matter is developed more intensively than among the students of a teacher. One of the large advantages with a course like this is that the student is no more and most important no less, than their identity on the net. You are not intimidated by "normal" social handicaps like shyness, looks, speaking problems etc. The preconditions seem to be others, like primarily ability to express yourself through writing.

Time being the foremost variable of human interaction, rather than space due to the psychological permeation of that dimension (Bergson, 1912) This is obvious in that the space dimension is almost evidable and has a mere representation (Chaib, 1996) in the virtual room created for the Workspace. Time being the factor expressed as synchronous or asynchronous representation in the process of the student discussion. Being asynchronous in the beginning of the learning process and as it becomes closer to the deadline of the task the process becomes more synchronous. This process also accounts for the student's experience that the course was time consuming. This is due to the experience that synchronous interaction on the net with instant feedback is more effective towards the end of a task since the result needs to be summarized and systemized. This whereas the process of brainstorming of presentation of new ideas or thoughts is better presented in an asynchronous environment since it gives more liberty of thought for the particular student, since it is not met by a direct argument.

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Factors for Successful Telementoring of Preservice Teachers

Barbara Brehm, Ph.D., Curriculum & Instruction, Illinois State University, USA, bbrehm@ilstu.edu

Abstract: This research examines how telementoring can provide introductory field experiences for preservice teachers through Internet links with classroom teachers as well as improve student telecommunication skills. It contains a discussion of factors impacting successful mentoring derived from three semesters of data collection.

NCATE/ISTE standards (ISTE, 1998) require that students have a working knowledge of telecommunications and its use in the classroom. The State of Illinois and NCATE standards recommend more field based training such as Professional Development Schools (PDS) for preservice teachers. Although Illinois State University continues to increase the number of PDS sites, increased field placement is difficult given the numbers of students enrolled in elementary education (more than 2,000). This research examines how telementoring can provide introductory contact with classroom teachers as well as improve student telecommunication skills.

Campbell and Yong (1996) had preservice teachers at two universities participate in a collaborative Internet project to examine classroom issues from multiple perspectives. Additional objectives were for the preservice teachers to acquire skills with networking technology and to develop a positive attitude toward CMC. Data collected from assignments submitted through e-mail, e-mail messages, e-mail process journals, and interviews. Participants' use of e-mail and trouble shooting of technical problems improved during the semester. They also found that technology was more effectively learned when it was embedded in content-base projects.

Norton and Sprague (1997) studied on-line collaborative lesson-writing between pairs of inservice teachers and preservice teachers. They found that preservice teacher's attitudes about telecommunications improved both for personal use and use with students. They suggest that on-line collaboration between preservice and inservice teachers may be used to enhance preservice field supervision.

This research examined how telementoring of preservice teachers (students) by practicing teachers can be an effective extension of classroom experience and identifies factors which promote successful mentoring. A pilot study was conducted, fall 1997 (Brehm, 1998). During that semester and the two following semesters, data were collected using questionnaires, journals, interviews, e-mail exchanges, and Web discussion forum interactions.

All students and mentor teachers had access to Internet e-mail and the Web from their school computer, home computer, or university computer labs. Students received two hours of Internet training. All teachers were experienced Internet users.

A discussion of factors impacting successful telementoring follows a brief summary of each semester's research. Resulting suggestions are divided into mentor recruitment, type and structure of the interaction, and the process of the interaction.

The first two semesters, undergraduate students were enrolled in language arts methods classes taught by the author. The third semester students were enrolled in an introductory methods class, Curriculum, Management, and Assessment. During Fall 1997 (Sem I), mentor teachers were enrolled in a Language Arts & Technology class delivered on-site in a school district. The groups discussed language arts related topics on netWorkPlace, a Web discussion space. During Spring 1998 (Sem II) and Fall 1998 (Sem III), individual e-mail between mentors and students was added to project. Mentors were assigned to individual students to personalize the interaction and create community (Brehm, 1999). Figure 1 illustrates the project participants by semester.

	Fall 1997 (Sem I)	Spring 1998 (Sem II)	Fall 1998 (Sem III)
Students	24 language arts class	23 language arts class	65 intro education class
Teachers	34 single district class	13 many districts	37 many districts

Figure 1 Telementoring Project participation by semester.

Based on suggestions from the Fall semester 1997, modifications were made in the recruitment of mentors, building community, and the types of mentoring activities planned for Spring semester 1998. Community between preservice teachers and mentors was built through pairing of a teacher with two students, an introductory e-mail exchange, the development of a collaborative project, and a campus visit by the mentors.

After the initial introductory e-mail exchange, pairs identified a topic for a thematic unit that the classroom teacher was currently teaching or developing for the future. The preservice teachers developed a lesson plan for the unit and the teachers gave feedback on the lesson plan.

Students reported pleasure in creating a lesson plan for a real classroom. Students had some difficulty creating lessons that were appropriate for the developmental level of the students and lasted the length of time that they were designed to cover. An unanticipated finding was that all of the teachers appreciated the new ideas in the preservice teacher's lesson plans and taught part or all of the lesson plan in their classrooms or planned to do so during the 1998-99 school year.

A frustration of the researcher was that some teachers were reluctant to send negative feedback to the students resulting in a few lesson plans that lacked quality even after revision. As a result, the role of the researcher for fall 1998 was changed from a teacher responsible for grading to a moderator responsible for student and mentor support. Responsibilities of the moderator included solving technical problems, posting bulletins and information, encouraging participation, and solving communication problems between mentors and students.

During Sem III students discussed course content (curriculum, classroom management, and assessment) with mentors through e-mail and on a NetForum. At the end of Sem III, 65 students and 25 mentors completed open-ended questionnaires about the class. When students were asked what they learned from the mentoring project, they reported the following: ideas for teaching from real teachers (28%), content (27%), Technology (13%), and very little or nothing (13%). Teachers reported the benefits of participating as reflective thinking (45%), helping future teachers (25%), and fresh ideas (15%).

Students reported that mentors rated as outstanding or good (66%) responded quickly, answered questions in detail were knowledgeable, and enthusiastic. Mentors rated as fair or poor (19%) mentors who responded infrequently. During the three semesters, mentors were recruited through required participation in classes, volunteer participation in classes, volunteers, and paid mentors. Mentors who volunteered were the most involved and enthusiastic. Mentors must also have convenient access to Internet to fully participate.

This researcher suggests that on-line discussion be integrated into classroom discussion for the most benefit. The mentoring should continue for at least two semesters for maximum effectiveness. Initial time is consumed with community building, overcoming technical problems, and learning the software. Technical problems were reported by 25% of the students and 20% of the mentors during Sem III.

Explicit structure is a requirement for telecommunications projects. Across all semesters, the most frequent suggestions from both groups for future mentoring projects was a rubric for evaluating the participation and a clear timeline of when electronic exchanges were due.

The researcher suggests that WebCT or similar groupware be used for mentoring. Such software allows e-mail, discussion participation, and chat with one sign-on. It also allows student work or presentations to be posted for student and mentor review. Pictures of mentors and students can be posted, Web pages can be downloaded or linked, and FAQs can be posted to save the moderator and participant's time.

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New Technologies in Secondary Education for Rural Areas: Integrating Information and Communication Technologies (ICT) in Rural Secondary Education Centers

Lydia Montandon, Elena Coello, José M. Cavanillas
Education & Training Unit - International Telematics Applications Department
Software Engineering Division, Sema Group sae,
Albarracín 25, E-28035 Madrid,
Tel: +34 91 440 8800; Fax: +34 91 754 3252;
LydiaM@sema.es

Introduction

This paper presents the research project called A PONTE. The overall objective of the project is to design the appropriate setting and perform a range of "pedagogical experiments" integrating the use of Information and Communication Technologies (ICT) in rural secondary education centers. The main goal is to observe the inference, identify solutions and establish clear guidelines for similar cases in other regions with a considerable rural population, not only in Europe, but also in farther regions.

The research within A PONTE is carried out in the areas of Galicia (Northwest Spain) and Northern Portugal. Although part of two different member states, both regions show a similar model, human townships as well as correspondences in terms of socio-cultural and geographic features.

Setting the context

Two fields of study have been considered to constitute the research framework of the project: the use of ICT in education and the rural areas' idiosyncrasy. A third underlying field of interest is the issue concerning the gap between secondary education and university studies.

It is of common sense that the introduction of new technologies into educational contexts requires a transition from traditional learning methods to innovative ones. It is also widely accepted that distance education is one of the educational contexts which takes most advantage of the use of ICT.

Besides, rural areas, defined as such as they have to cope with specific problems as large distances and lack of appropriated physical means of communication, are conditioned by a hostile geographic environment making access to information resources difficult. For example, the information available for pupils when deciding on the type of studies they want to take up seems to be insufficient in many cases. Consequently the passage from secondary education to university is much more complex than the transition between the different levels of education. Both studied regions, Galicia and Northern Portugal, are aware that the use of remote applications using ICT is the best way to overcome the large existing differences between rural and urban population, or at least to reduce them.

Concerning the pedagogical framework underlying the setting and performance of the experiments, the following demonstration actions have been identified:

1. Many studies have highlighted that there is still widespread lack of awareness about the implications of using new ICT in education and training, and skepticism about the benefits. There is a need for broader dissemination activities to encourage the education communities to become involved.
2. In Galicia, surveys have shown that there is an important gap between secondary studies and university studies. The problem is that the only information given to the students finishing secondary schools on the possibilities to continue their studies is presented during a single day session and is far from being complete. A growing amount of web-based data readily available is provided by the Universities and

constitutes a valuable source of information that can be presented adequately to the students.

3. The consequence of low density and dispersion of population in rural areas is that classrooms are made up of small numbers of pupils. Due to this fact and to the diversity of the curricula in secondary education, many subjects are chosen only by a few students in each school. This means that maintaining teachers in each center for all possible subjects is not affordable and seldom-demanded subjects are merely not on offer in many institutions. ICT applications can help to overcome this situation, as a wide range of tools to support distance education is available on the market. Besides, participation in multicultural projects involving the use of the Internet under European ongoing initiatives will be encouraged and supported.

Project development

The methodology applied in this project is based on the following approach: educational needs analysis, demonstration and evaluation plan design, experiment setting implementation, results analysis and best-practice reports dissemination.

The report on educational needs is centered on the description and analysis of aspects susceptible to influence the pedagogical experiment's design. These considerations allow establishing the selection of schools in which the experiments will take place and describe the actual state of rural secondary education in Galicia and Portugal with special focus on issues related to the use of ICT. The crucial issue within A PONTE will be to define the evaluation parameters in order to carry out the experiments and assess the results. The objective is to identify and analyze the project evolution, from complete successes to deep failures. Evaluation actions and reports will focus on issues as the response to the regions special needs, the pedagogical value of the experiments, the technical value of the ICT applications implied, the socio-economic impact and the consequences for educational institutions. The intermediate analyses and the final results will be presented through public workshops involving teachers, students and parents. The interactive character of these workshops should allow the transfer of knowledge between the different actors, the confrontation between designers and end-users, and will give to the organizers the opportunity to collect feedback data.

As research on the impact of the use of distance learning facilities in rural areas for pupils to access less taught subjects will be one aspect of the demonstration, a web-based environment (called Aula da Ponte) will be integrated according to the specific needs of rural schools. This tool will provide an environment enabling instructional designers, monitors and students located in different rural areas to communicate and study in an interactive way. The idea is to integrate already developed components, as a preliminary study demonstrated that a valuable quantity of existing tools is available on the market.

Expected outcomes

At local level, the expected outcomes of the pedagogical experiments should be an increase in the awareness of ICT applied to education in Galician and Portuguese Secondary Centers, as well as the schools' access to learning communities, international ICT services and educational programs. On a wider scale, experience gained within A PONTE, guidelines and best-practice reports on how to use ICT for pedagogical purposes in rural areas should be made available to the international educational community.

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Hybrid Online Courses & Strategies for Collaboration

Marshall Soules, Ph.D.
Coordinator Media Studies,
Malaspina University-College,
Nanaimo, British Columbia, Canada
soules@mala.bc.ca

Hybrid web-based courses combine technologies of distance delivery with face-to-facc interaction. This combination of modes poses special challenges for instructors who hope to foster collaborative learning environments based on (inter)dependencies (Bourdeau & Wasson 1998). This discussion is based on the delivery of a number of online courses since 1996, mainly in the fields of Media Studies and Computer-Mediated Communication (English). (Websites for these courses can be viewed at http://mala.bc.ca/~soules/.)

The theoretical contexts for this discussion have been explored in previous papers (Soules 1997; Soules 1998) which explore how online learning takes place in a distinct performance medium, and how it is important for instructors to reflect on the new expectations, demands, and social dynamics resulting from the new medium. Research on video-conferenced courses offered in 1996 (Soules 1996) revealed that "student satisfaction and success are highly dependent on [a] sense of membership, or engagement by the learner in the educational process. Our research found, for example, that unlike the membership construct, the technology itself does not lead to high satisfaction rates: once the purpose of establishing clear and reliable communication has been met, further efforts to develop more sophisticated systems are not likely to result in more student satisfaction. Similarly, once basic student support services have been provided, more elaborate administrative functions do not significantly increase student satisfaction or success" (Dolan 1996; Soules 1998).

What we discovered in our attempts to create collaborative interdependencies was the need to supplement classroom lectures and discussions with web-based learning resources. Students at the remote video-conferencing site felt they were missing something that those in the host classroom were experiencing, and asked that lecture notes and resources be available to them through other means. For this video-conferenced course, we evolved a hybrid mode which combined synchronous delivery technologies with supplementary, often redundant, web-based technologies designed to foster greater course participation and involvement for an "ensemble" of learners.

Since 1996, I have delivered a number of courses which combine elements of face-to-face with online, web-based delivery techniques. In some cases, all course participants were expected to attend classroom discussions, and then accomplish certain online learning tasks in lab sessions. In other course configurations, there have been two sections of the same course: one section met in the classroom, the other was solely for online students studying from a distance. All course materials were provided on websites, and assignments for both sections were submitted electronically. In still another version of the hybrid online course, I accepted students who wanted to take a course completely online which had been scheduled as a traditional classroom session. Finally, I have delivered courses with no scheduled classroom meetings. In all of these instructional scenarios, the hybrid nature of delivery posed specific problems, and revealed important insights into the dynamics of online learning.

As one might expect, online students often express the suspicion that they are missing something. Not only are they missing what they might learn from any material presented in class not included in the resource materials, they are also missing the learning that comes from discussion and interaction. Additionally, some people do not find it easy to ask questions online. These concerns are valid in my experience: students do benefit from classroom discussions, from the clarification of difficult material, and from interaction with an instructor and each other. Online students do not participate as easily in the process that a group goes through in the construction of a commonly-held understanding of material--not that everyone has to have the same understanding, only that the group has collaborated on an exploration of the material from which they take their own conclusions. This collaboration defines, in effect, the condition of interdependency.

These impressions that something is missing in the educational experience is most keenly felt by students who take a course completely online and know that there is a group of students who meet regularly in the classroom. If all the students are online, the feeling that something is missing is less urgent.

Self-motivated online students are able to compensate for their distance from the classroom by making use of email and newsgroups to communicate with both instructor and other course participants. However, for students who are less sure of themselves or their abilities, I am discovering that there are a variety of strategies that can be used to foster membership in the course and its activities:

1. One obvious strategy for promoting a learning synergy in hybrid courses is to ensure that the online learning resources available from the website are up-to-date and as engaging as possible.

2. Similarly, it is important that instructions for assignments are clear, and do not require further in-class explanations to give fuller direction. For most of my online assignments, I specify the form and goals of the assignment in detail, and allow course participants considerable latitude in their choice of approach to the content.

3. I grade the assignments of online students first, and respond to all email queries as quickly as possible to demonstrate that someone is responsive to their needs.

4. After the earlier video-conferencing experience, I have used mainly asynchronous technologies for online courses--email and distribution lists, newsgroups, and websites. My use of newsgroups has evolved considerably, and become more structured. Where previously I asked students to participate in a newsgroup discussion over a period of time and graded them on their level of participation, now I assign short weekly assignments which are posted to the course newsgroup. These short assignments reflect on the course material, provide writing practice, and generate focused discussion. These weekly assignments allow me to monitor who is actively participating in the course. Collectively, all course participants are building a tangible dialogue related to the course content.

5. Since most of the courses I deliver emphasize writing skills, I ask participants to collaborate on the production of an electronic journal which provides tangible evidence that all course participants can contribute equally to the learning experience. It is not altogether surprising that those who volunteer for the production and design of these journals are often online students who want to participate more fully.

Strategies for creating membership in hybrid online courses should acknowledge that we are operating in a unique performance medium with its own protocols for effective interaction. The use of structured newsgroup discussions related to course material, and the production of electronic journals of participants' writing offer tangible evidence of interaction and collaboration. Participants are able to build dynamic documents testifying to their participation, and thus their rightful membership in the course.

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A new concept for designing distance education courses for students of electrical engineering

Dirk Thißen
Automaton Technology Group
Hagen University
Germany
dirk.thissen@fernuni-hagen.de

Dr. Birgit Scherff
ATR-Industrie-Elektronik GmbH & Co.KG
Viersen
Germany
b.scherff@atrie.de

It is one of the concept's inherent objectives to be applicable to many of those subjects concerned with electrical engineering's curricula. To meet these special requirement, a structure was chosen, that consists of eight different modules and six tools.

The modules could be derived from investigations of the general demands of professional life nowadays and an analysis of the curriculum's single subjects' contents. They have two things in common, first of all, each of them is in a way related to a special subject's contents and second, they try to combine computer based learning with traditional methods in learning, e.g. solving exercises by writing on a piece of paper. But the modules differ with regard to the learning objectives, didactic approach, and the use of media elements.

name	description	learning objective
course	offers the contents of special subjects as it is done in specialist books, here however in multimedia form	gaining knowledge by instruction
exercise book	offers a number of exercises, derived from a typology of exercises, especially elaborated for engineering subjects	using knowledge to solve problems
media corner	presents strategies, hints, and tools for autonomous information acquisition	knowledge acquisition and knowledge processing
base knowledge	gives a brief summary of other subjects' contents necessary to comprehend the special subject	gaining basic knowledge
real life	points out the actual use of special subjects' contents in reality and professional life	making knowledge transfer-able
laboratory	offers simulation environments for special subjects' contents	gaining knowledge by autonomous exploration
formulary	present a combination of single subjects' formulas	gaining basic knowledge
cup of coffee	offers opportunities for recovering	learning by entertainment

Table 1: Modules recommended by the new concept. The table gives the name, a short description and the learning objective for each of the eight modules.

In dependence of the typical demands of a single subject, the developer can decide for his current distance education course, whether to stress one or a few of the eight modules, perhaps leaving out one and so on. In addition to that, it is still left in the hands of the special subject's expert to determine the composition of a certain animation, figure, video, etc.. The concept's intention is to provide a didactic framework. This framework is enriched by a detailed description of functions for each module. Thus, it serves as a guideline for the developer to facilitate an implementation of the modules in the concept's sense.

Each module should be divided into smaller information units, each of which can be visualized on a screen of its own(using scrolling if the information unit's size exceeds screen possibilities for visualization). For accessing the modules' information units, the concept recommends a linear navigation structure for each module, enlarged by a hypertext/media structure connecting all modules. This allows guided as well as self-determined exploration of the single information units.

In addition to the modules, the new concept recommends six tools for coordinating and supporting the student's learning sessions to become more efficient ("to do things in the right way") and effective ("to do the

name of the tool	description
learning optimizer	offers adaptability to different strategies in learning, which have been detected by empirical research
flipchart	gives an overview of the user's navigation schemes, comments, times for learning, test ratings, etc.
calendar	offers to plan a single learning session and to elaborate learning schedules
plant	motivates the student using the Tamagotchi-effect[1]
search engine	offers quick access to special information units or parts of them
calculator	offers a scientific, interactive calculator

Table 2: Tools for supporting students' learning sessions. The table gives the name and a short description for each of the six tools.

As the tools *search engine* and *calculator* are standard in highly sophisticated computer based learning, the other four tools are new. They could be derived from reflecting the concept's authors' experiences during their studies of electrical engineering. They are all intended to take advantage of the medium computer, that is the general possibility of recording learner's activities data.

Following the new concept when developing a special distance education course, has three great advantages:

- With its modular structure the human learning process (adopting knowledge up to using it) is not only supported on the whole, but due to the clear separation, it is in the student's hands to choose his own aspiration level at any time of his learning session.
- With the integration of traditional methods in learning and computer based learning in a didactic concept an pedagogical surplus value could be achieved.
- Assimilating the tools *learning optimizer*, *flipchart*, *calendar*, *plant* further contributes to the student's ability to learn.

Up to now, the concept has exemplarily been realized in form of an HTML-based distance education course for the contents of *mechanical engineering basics in automation technology*.

[1] In 1997 a popular and controversial discussed electronic toy for children. Children have to keep alive a figure in a mini computer by regular care.

The Effectiveness of Metasearch Tools in Web-Based Information Retrieval

Judi Repman
Randal D. Carlson
Department of Leadership, Technology and Human Development
College of Education
Georgia Southern University
Statesboro, GA 30460-8131
jrepman@gasou.edu
rcarlson@gasou.edu

Basch (1998) refers to metasearch tools as "umbrella" sites, where the user enters a query once. The meta-engine then translates it and sends the query to several search engines and/or directories simultaneously. Notess (1998) calls these tools megasearch engines or parallel or multiple search engines. In looking at the features of tools that have been labeled metasearch engines, one characteristic differentiates "true" metasearch tools: following a simultaneous search of multiple search engines or directories, the end user is given a single integrated set of results. In the technical terms used by Dreilinger and Howe (1997) a metasearch tool must contain three components: a dispatch mechanism, interface agents, and a display mechanism. Choice of search engines for a specific query is the function of the dispatch component, while interface agents "translate" the user's search query into the format required by a specific search engine or directory. When the results have been obtained from the different search tools, the display mechanism merges them. Sometimes the results list can be sorted or ordered as the user specifies. Most metasearch engines also claim to have display mechanisms that eliminate or reduce duplicate links and which may check whether or not links are active.

True metasearch tools also fall into several categories. The largest group is web-based and free to anyone using a web browser. Next is a group of desktop applications. Some can be downloaded from the web for free and are used as an add-on to a single search engine. InfoSeek Express < http://express.infoseek.com/> is one example in this group, as is Sherlock, which is integrated into the new Mac O/S 8.5 and is the only desktop tool that can be used on a Mac. The final category also consists of desktop applications, but these metasearch tools are shareware or licensed software. Some sort of registration fee or purchase price must be paid either at the time of download or following a trial period. Sherman (1998) labels these as search software utilities or agents since they reside on the user's computer.

Unfortunately, there are some fairly significant limitations to metasearch tools. Basch (1998) likens the approach of many of these tools to the lowest-common-denominator effect. Interface agents may not be sophisticated enough to translate a Boolean query into the syntax required by a specific search engine. Advanced searching features may only be available as part of a registration/customization process. This approach is only practical in single user computer settings, a luxury few public, school, or university libraries would find affordable. The speed of metasearch tools also means that they retrieve only the few highest ranked hits from individual search tools. Most metasearch tools will time-out search engines or directories that take too long to respond to queries. (Notess, 1999) The cost of this emphasis on speed means that most metasearch tools sacrifice comprehensiveness, returning from 20-50 results per query.

The comparison and evaluation process began by identifying metasearch tools. Lists of metasearch tools were identified at the Open Directory Project <http://dmoz.org/>, Yahoo! < http://www.yahoo.com/>, and Beaucoup! <http://beaucoup.com/>. An initial examination of the tools indicated that while many were called metasearch engines, the majority did not fit our definition. After eliminating some tools that didn't seem to be functional, we were left with a set of 16 "true" metasearch tools. We examined each of these in depth, reading any background information, FAQ's or descriptions of features that were available and tested each with several sample queries.

Developing criteria for identifying top performing metasearch engines was an interesting task. Since successful searching is closely related to relevance this becomes a qualitative assessment. None of the metasearch tools examined provided anything beyond a general statement of how relevance was determined, since this information may be viewed as proprietary. A metasearch tool met our initial criteria for success if a result matching our information need was listed on the first page of the results display. The number of search engines/directories available, the look and functionality of the interface, and the results display were also important factors in arriving at any final judgments. Some results displays were so cluttered with advertising that the user has to scroll down almost a full screen before any results were visible. Metasearch tools that made it easy for users to customize their search by selecting which search engines to use or specifying how results should be presented were also viewed more favorably. Another convenient addition was a window that followed you on your desktop so that you could search immediately. Finally, metasearch engines using frames when results are linked were identified. When this happens end users don't see the URL for the site they have linked to in the location bar, which means that writing down or bookmarking a URL is problematic. This feature can be toggled off, but that is an unnecessary, and confusing step.

On the whole, most of the 16 metasearch tools examined performed adequately. None failed to answer any of our queries, but in some cases an acceptable hit was well down on the results list. Duplicate links were usually eliminated. In the end, we agreed that five metasearch tools (byteSearch <www.bytesearch.com>, Mamma <www.mamma.com>, Metacrawler <www.go2net.com/search.html>, ProFusion <www.profusion.com>, and SavvySearch <www.savvysearch.com>) were superior performers but did not attempt to rank them. Metasearch tools offer an excellent alternative for end user searching. All five of our top group did an above average job of translating a search into the syntax required by different search engines and directories. They provide a quick way for the end user to have some sense of the quantity of web resources available on a topic. If users pay attention to the attribution of results to search engines, it is also possible to determine which individual search engine might be the most promising search for more advanced or in-depth searching. The breadth of SavvySearch and the options available with ProFusion make them stand out from other metasearch tools currently available, but as with most discussions of web resources these features can and will change. Try to forget some of the negative comments you've heard about metasearch tools in the past (that is, two months ago). Their capabilities continue to improve and our experience has shown us that they have an important place in the information searching process.

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Classroom Integration of Digital Humanities Materials

Edward John Kazlauskas
Instructional and Human Performance Technology
School of Education
University of Southern California
United States
kazlausk@mizar.usc.edu

Introduction

ISLA (Information System for Los Angeles) is a digital research resource of Los Angeles materials held in a very large, University-based archive. These resources are in multiple information formats and are used for teaching, research, and public access. The scope of resources includes the widest variety of information from all historical periods, linked by spatial and temporal coordinates. The primary, long-term goal is to create a system that will enable all kinds of users, including students, to search and access, via the WWW, a rich and diverse range of research materials about a specific geographic location. The ISLA project has been supported by many organizations, including the U. S. National Endowment for the Humanities (NEH), the City of Los Angeles, and the Thomas Brothers Map Company. It is envisioned that the software system will be transportable and other cities/locations can acquire the software to provide access to their own digital resources

The first version of the system was released in September 1998. This is Version 1.0, the proof-of-concept. This version contains a library of multidisciplinary digital materials (texts, photographs) and provides components of the sophisticated search and retrieval method.

This paper provides: 1) an overview of the current system; and 2) a description of ISLA training and development of K-12 curriculum integration plans

Overview of Current System

The ISLA interface provides space/time/fulltext/format indexing to allow for searching and retrieval of materials. This interface allows access by the conventional indices of author, title, subject, and other cataloging fields, but in addition the attributes of Geographic Information System (GIS) vector layers, and timeframes. A user, a student for example, can take a "core sample" of a geographic area, such as a neighborhood, street, or census area and examine this through layers of time.

The current materials/resources in ISLA include photographs, newspaper texts, aerial and satellite images, digital spatial data made available from Thomas Bros. Map Company and the Bureau of Engineering of the City of Los Angeles, data from the 1939 WPA (U.S. Work Project Administration), and land use maps. Additional items are being added to the growing ISLA digital archive. Other material formats, such as audio-visual media (audio, video, film) and demographic data, will be added in the future.

Education Applications/Curriculum Integration

A view of this project is that one of the keys to its success is the integration of ISLA into the classroom. We believe that ISLA is particularly suited to assist in the fostering of participation and critical thinking skills, and in the development of information literacy skills. At present, graduate students in education (teaching and learning) and in instructional technology are being trained, using the training-of-trainers model, in the use of ISLA. They, in turn, are providing training sessions for school administrators and teachers, and to a group of local teachers involved in an in-service program in computer competency and curriculum integration

Individuals and groups are developing humanities and social science focused lesson plans for their specific K-12 curriculum interest level. ISLA-based curriculum planning can also include integration of other content areas, such as mathematics, inclusion of other supporting instructional resources, and connection to standard curriculum guides, such as the California History-Social Science Framework. Most planning includes a description of the learning objectives, required tasks, and specific learning activities associated with ISLA, as well as a description of methods for learner evaluation. The following are two possible examples of ISLA curriculum scenarios.

Geography (Reading Maps); Social Science (Demographics); and History

The general learning objectives associated with this curriculum scenario include the following. Learners will understand and work with cardinal orientation, scale, and proximity; interpret map symbols; work with concepts of social categorization and elementary comparative statistics; understand the settlement patterns of different ethnic groups during different historical periods; and understand the modes of livelihood practiced by ethnic groups in various historical periods.

The tasks required of the students include: orientation of unmarked aerial photos, correlation of topography with cartography, comparisons in space, time, and by category; searching selected neighborhoods for evidence of ethnic settlement and ways of life.

The activities include the following. Students choose or are assigned different regions of the city and each is asked to construct a changing demographic profile of that neighborhood at three different points in time: 1939, 1960, and 1990, on three variables: occupation, race-ethnicity, and average income. After viewing and extracting data from ISLA, students perform simple summary proportion statistics and charts using typical spreadsheet programs. Students share results and then write reports about the nature of the changes within regions over time, and across regions, offering hypothetical explanations for those differences.

Art and Architecture

The general learning objective includes developing an understanding of historical architectural styles and their creator's intended meanings.

Tasks include identifying a style in different types of construction and then "reading" unidentified constructions to determine date of construction.

Activities include the following. Students search ISLA to discover buildings built during the 1920s, using dates in photographs and using "year built" data in the 1939 WPA Household Survey. They search for photographs and identify Art Deco styles in both downtown office buildings and residential structures. Students form teams and each team assembles a collection of residential and commercial buildings from the period 1910 through 1940. Each team attempts to identify the buildings constructed based on the styles of the sample chosen by the other team. As appropriate and if possible, teams will visit these buildings.

Conclusion

The ISLA archive continues to grow and the interface is still undergoing development. But in the meantime teams of education students and local teachers will continue to evaluate ISLA in terms of its curriculum integration capabilities and will develop additional ISLA-based lessons for eventual classroom use.

Information on the World Wide Web: Is It Fact, Fiction, or Scam?

Judy E. Mahoney
Cerner Virtual University
Cerner Corporation, United States
jmahoney@cerner.com

Now available on the World Wide Web (WWW), information on any subject, by anyone! There exists, for the first time in history, a channel that spans the globe where freedom of expression is open to anyone. It is this openness that signals a note of caution. Little of the information on the Internet is filtered as it is in the more conventional channels such as in libraries, newspapers, magazines, books, or television. What is accurate? Evaluating information available on the Internet is crucial if the information is used as teaching material, learning resources, or research reports.

Critical literacy is a prerequisite skill that must be fostered when using information from the Internet. This invaluable skill will carry over into a real world that contains ever more sources and quantities of information. On the Internet, where anyone may publish anything relatively easy, the huge quantity of extant information makes the use of search engines commonplace. However, search engines cannot rank the returned documents for credibility. This is left to the student, teacher, or researcher, who is faced, with a potential mountain of chaff mixed in the kernals of knowledge. As such, the source is not always easy to evaluate, especially according to reputation, because of the vast number of, often anonymous, authors involved. In the end, it is usually left to the document to speak for itself in terms of its content validity, and ultimate credibility lies in the critical literacy of the reader. (Farah, 1995).

An Example: The staff at Bishops High School, Newfoundland, Canada began to question the validity of information included in recent student term papers. Students were accepting almost all home pages as accurate regardless of content because they were "in print." Print materials commonly used for student research have usually passed through either peer research or editorial boards before publication. However, no such validation exists for Internet materials, which may be posted by both genuine authorities and those with questionable credentials. In response to problem, the Memorial University Faculty of Education Action Research began a project to develop a set of guidelines for students and teachers who want to use the Internet as a source of information for research papers. (Doug F. etal. 1996), As a basis for their guidelines they define validity as: The quality, fact or condition of being supported by commonly accepted facts or recognized authorities. Additionally they suggest using two types of validity with respect to home pages. The first, "concrete validity" is based upon a page being well referenced to known authorities. The second, "context validity" is based upon the content of a page being confirmable with accepted facts. In his presentation at the Association for Educational Communications and Technology, Dr. Don Descy of Makato State University in Minnesota defined information accuracy in using a two part definition containing these same basic points. (Descy, 1997).

Using above definitions as a basis, the following is a list of pertinent questions developed as a guideline for determining the accuracy of information gleaned from the Internet.
With respect to "concrete validity" the reader should be able determine the answer to the majority of the following questions.

- What is the source of the information?
- Does an individual, group, or organization sponsor this site?
- Can the location of the site be determined by the URL? (*See information on Uniform Resource Locator)
- Is the author/publisher a recognizable authority?
- Is the author the creator of the information or a compiler of other information resources?
- Does the author/publisher provide his/her e-mail address?
- Is there a common link to the page from recognized authority?
- Does the page provide other sources that could be contacted for confirmation or further information?
- Does the page cite a bibliography or provide references to confirm the accuracy of the information?

- Has the site been reviewed by a "content" reviewing agency?

Some pages/sites contain information that appears valid but does not meet the majority of the criteria for "concrete validity." To deal with these pages or further confirm the accuracy of the given information, which appears valid in comparison to other pages, "valid in context," the reader should be able to answer all of the following questions.

- Who is the intended audience for this site.
- What is the intent of this information?
- Why was it put there - entertainment, educational?
- Is the information presented in a well-reasoned manner?
- Can you detect any evidence of bias from reading the page?
- Is supportive information available in print?
- Does the information contradict or confirm the information from other sources?
- Does the site have links to other sources on the same topic?

Developing skills in determining the accuracy of information gleaned from the WWW has far reaching potential for lifelong learning. The Internet provides a virtual classroom for hands on learning of critical thinking skills needed in the real world to avoid the pitfalls of false advertising, pseudo-science, narrowed reality (gangs, cults), get-rich-quick schemes (scams, pyramid schemes, mail frauds), political rhetoric, indoctrination, media bias, twisted statistics, and other ills that prey on the unsuspecting in this information society we live in.

*URL information example: http:// www.mannlib.cornell.edu.reference/workshops/surf/url.html

The Protocol: This tells the Web browser how to load and interpret the document. For example, http:// tells the browser that the file is a hypertext document. Other protocols include gopher, ftp, and news.

The Server: The second part, www.mannlib.cornell.edu is the name of the machine on which the Web page is located. The following domain names provide information about the type of organization using or maintaining the server.

".com" names are used by commercial (for profit) organization.
".org" names are usually used by non-profit organizations or groups.
".edu" is for 4-year, degree granting colleges/universities.
".net" is for network infrastructure machines and organizations.
".gov" is for US Federal Government agencies.

The Path: The last portion of the URL, reference/workshops/surf/url.html, gives the path or directory of the document plus the name of the file itself. When the symbol "~" is included in the path it often denotes a private directory or file. To determine more information about the files located on a particular server, in the location window, try deleting the file and folders - one at a time from right to left. (First delete the file and press enter to logon to the site, then delete each of the folders in turn from right to left, trying to logon after each deletion. Many times this will open up other directories and files also housed on the site) Suggested sites for additional information Truth, Lies and the Internet http://www.cnet.com/Content/Features/Dlife/Truth/ss01.html; Kathy Schrock's Guide for Educators http://www.capecod.net/schrockguide/eval.htm The Six Quests-- WWW repair - Evaluative approaches http://www.ciolek.com/PAPERS/QUEST/Quest6.html Information Quality WWW Virtual Library http://www.ciolek.com/WWWVL-InfoQuality.html.

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Applying Theories used in Drama to the Design of Educational Multimedia

Kevin A. Harrigan
University of Waterloo and TeleLearning Network of Centres of Excellence
Department of Computer Science, University of Waterloo, Waterloo, Ontario, Canada, N2L 3G1
Email: kevinh@uwaterloo.ca

Introduction

Over the past ten years we have been involved in the design and implementation of many Educational Multimedia applications. We have found that the selection of media has often been a difficult decision as we try to balance the "best' media to meet the instructional objective with practical considerations such as cost and availability of appropriate designers.

Since 1993, we have applied several theories used in Drama to the design of six Educational Multimedia applications as an additional design tool to aid us in the selection of media in the interface. These theories have proven useful as design aids as well as a documentation tool for the design process.

Background

In her book "Computers as Theatre", Laurel (1991) argues that dramatic theory, which is centuries old, can be applied directly to the contemporary field of Human-Computer Interaction. She suggests that using dramatic theory provides "a new place to stand" for interface designers. She explains that Aristotle's theory of drama provides six points which are to be considered when creating a play or analyzing a play which has already been completed. A successful play should contain all six points. The six elements are: action, character, thought, language, melody or pattern, and spectacle or enactment.

The ideas put forth by Laurel have received considerable attention (see for example, Frenkel 1994) but we have struggled with applying these elements to the interface design of our Educational Multimedia applications because Laurel does not provide practical examples. Within the overall spirit of Laurel's argument, we have been using three dramatic theories which provide practical techniques that we can use in the design of our interfaces. In the following section we will describe these dramatic theories.

Dramatic Theories

A) Laban's Mastery of Movement System

Laban (1975) collected information about human movement and in fact the terminology used in the field evolved on the basis of his work. His book "The Mastery of Movement on the Stage" referred to movement on the stage in the theatre but Laban also used his ideas of movement in relation to the stage of human life. According to Laban, humans move in order to satisfy a need. For example, Eve had to move to pick the apple from the tree of knowledge. An actress representing Eve must attempt to pick the apple from the tree in an appropriate manner so that an audience member who is not familiar with the biblical story would be made aware of both her aims, the tangible and the intangible. The movement is all that the audience member has to interpret this moment. It should be noted that, according to Laban's definition, movement includes sound.

Laban determined that there are four motion factors: time, weight, space, and flow. Each motion factor may have one of two measurable and classifiable effort element states: fighting and yielding. Categorizing movement in this manner allows either for the analysis of any given movement or for guidance in creating effective movement. Thus, for example, a director should be able to consider any actor in any given scene and categorize the actor's movements in one of the potential states. Also, any given actor should be able to use these motion factors as a guideline in rehearsal.

B) Stanislavski's Source of Physical Actions and Intentions

Stanislavski's (1976) book "Creating a Role" changed the way many actors and acting schools approached acting. Stanislavski's main thesis was that the action performed by the actor is the most important part of acting and that feeling is not important:

> " Let each actor give an honest reply to the question of what physical action he would undertake, how he would act (Not feel, there should for heaven's sake be no question of feeling at this point) in the circumstances given by the playwright.... When these physical actions have been clearly defined, all that remains for the actor to do is to execute them... Note that I say show physical actions, not feel them, because if they are properly carried out the feelings will be generated spontaneously. If you work the other way and begin by thinking about your feelings and try to squeeze them out of yourself, the result will be distortion and force.... "

Stanislavski makes many points such as for every action there should be a beginning, a middle and an end and each of these structural elements should be played clearly and precisely. He also says that the context (or moment) of the movements are very important. He explores the purpose of the moment as follows:

> " To have any meaning, whatever happens on stage must have a purpose. It must serve some end beyond some accomplishment of the action itself. The meaning, both for the actor and the audience, rarely lies in the action but in the purpose for which it is done. Even loading a gun or mixing poison is not itself dramatic. We must know why, toward whom the lethal effort is directed (McGaw 1975, p. 23)."

C) Perceptual Mode Dominance Theory

The psychotherapists Bandler and Grinder (1975-1976) have a very simple yet powerful theory called Perceptual Mode Dominance. The theory says that of the five senses - hearing, seeing, touching (body sensations in general which are called kin aesthetic), tasting and smelling - the first three are the most important. Interpersonal communications are almost totally governed by these three modes. Human beings tend to favor one of the three modes. They tend to perceive life dominantly either through what they see, what they hear, or what they touch (or kinaesthetically feel). They learn or understand best if the information is communicated either visually, auditorially, or through physical-spatial means.

Conclusion

The three dramatic theories introduced in this paper do appear to be a useful tools for aiding the design and development of Educational Multimedia applications. Our current interest is to (a) continue performing experiments to empirically evaluate the usefulness of the theories and (b) get actual Instructional Designers to use these theories as a tool in the Instructional Design process so that we can get their feedback. Our long-term interest is in the possibility of incorporating these tools into an on-line Instructional Design toolkit that we have developed.

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Providing Advising and Support Services to Distance Learners: Helping Distance Learners Connect with the University

Joanna C. Dunlap
School of Education
University of Colorado at Denver
U. S. A.
Joni_Dunlap@ceo.cudenver.edu

[**Note:** A full version of this paper, with bibliography, is available at http://www.cudenver.edu/~jdunlap]

Generally, most definitions of the term distance learning include the concept of time- and space-independent teaching and learning. Lately, definitions also include the notion of employing information and communications technology, interactive video, and computer networks to enable asynchronous and synchronous learner-instructor, learner-learner, and learner-advisor interaction. Simply stated, distance learning provides learners with educational opportunities offered outside of a formal classroom setting, combining independent study with guided instruction that is coordinated by a central facility providing a network of educational services. Applying this definition, instructors, support personnel such as academic advisors, and technology combine to provide an instructional delivery system that fulfills high academic standards while being flexible and considerate of distance learners' constraints.

Learners who choose distance education often face a number of obstacles:

- They live in remote geographic areas.
- They have limited program options at conveniently located institutions.
- They have work schedules that conflict with campus-bound course schedules. This includes people who work shifts, travel frequently on business, work long hours, and/or are in the armed forces.
- They have personal and family commitments that conflict with campus-bound course schedules. This includes having children at home and taking care of aging parents.

The obstacles to fulfilling their educational goals and objectives give rise to special needs which must be met if distance learners, and the programs that serve them, are to be successful. The special needs that impact distance learners' success fall into two main categories: instructional/resource access and communication needs, and advising and learner support service needs.

Needs of the Distance Learner

The needs of the distance learner provide a starting place for determine what a distance learner support services program (DLSSP) must effectively respond to in order to ensure that learner satisfaction and success in meeting learning plans are maximized. The following list includes some of the more obvious needs of distance learners that should contribute to the shape of a distance instructional as well as learner support services program:

- To learn and accomplish learning plans. This is the primary need for the learner. All instructional and service program components should ultimately support this endeavor.
- To have access to what the learner chooses to learn at the time and in the delivery mode preferred by the learner.
- To receive accurate and timely information inclusive of the following:
  - Program offering requirements (i.e., degrees, certificates, and credentials).
  - Educational provider, policies and procedures (e.g., registration, payment of account, drop/add/withdrawal).
  - Course offerings and content descriptions as well as prerequisite/corequisite information.
  - Self-assessment tools available to assist the learner in evaluating eligibility and preparedness for courses and programs of interest.

- How courses/credits/competencies apply to programs or transfer.
  - Learning outcomes expected for courses and programs and their relationship to personal/professional goals.
  - Technical support assistance with required software and hardware for selected instructional delivery method.
  - Learner support service availability.
- To ensure individual attention from the educational provider. The learner wants to have one point of contact to the organization and have the DLSSP network internally to meet learner needs. The learner wants the educational provider to respond to learner needs rather than the learner adjust to the organization's structure.
- To have a relationship of support with educational provider staff. The distance learner wants acknowledgment, positive feedback and encouragement (as appropriate), an early warning system for unnoted obstacles or potential problems, assistance in clarifying and validating learning plans, and a responsive problem-solver/trouble-shooter to assist when any academic or administrative issue arises.
- To be referred appropriately when the point of contact is not able to address the learners concern.
- To have a sense of connection and community with the educational provider and other learners with similar learning plans.
- To have special learner needs (e.g., accommodation of disabilities) addressed effectively both in the instructional and service arenas.

Roles and Responsibilities of the Distance Learner Support Services Provider

The general roles and responsibilities of the Distance Learner Support Services Provider (DLSSP) that respond to the distance learner needs are summarized into three primary categories.

- Communication -- There must be a variety of means for the learner to connect with the educational provider to gain learner support services. Because the DLSSP is working with distance students, personnel must not only have excellent interpersonal communication and instructional skills to be able to concisely and clearly explain policies, procedures, and requirements, but be able to effectively utilize those skills in a telephone- or computer-mediated communication environment.
- Information -- Information should be made available to learners in hard copy and Internet form. In order to accomplish this, a DLSSP need to be able to plan for learners' informational needs and organize materials and resources to meet those needs, develop and write supporting materials, and present information verbally and in written format in a clear and concise manner.
- Learner Advocacy and Liaison -- Addressing all learner issues with a customer service orientation, the DLSSP serves as the interface with the learner and the educational provider. The most critical aspect of being an advocate and liaison for distance learners is advising and counseling, which includes:
  - Understand learners' unique characteristics and ability to adjust advising and learner support style appropriately
  - Develop learners' personal learning plans
  - Clarify learners' career and learning goals
  - Select of appropriate courses and other educational experiences
  - Increase learner awareness of resources available
  - Evaluate learner progress toward established goals and provide appropriate response

Web and Computer-mediated Communication Support and Structure for Distance Learner Support Activities

Examples of online learner support services for distance learners that utilize the Web and other computer-mediated communications technologies can be found at http://ceo.cudenver.edu/~Joni_Dunlap/lssexamples.html

Characterizing Forms of On-line Participation in a Teacher Professional Development Setting

Beth Rosenstein Cole, National Center for Improving Student Learning and Achievement in Mathematics and Science, University of Wisconsin – Madison, USA, brcole@facstaff.wisc.edu

Electronic communication is a new and expanding medium for the professional development of teachers. This paper reports on some work conducted to begin to develop a framework for discussing the forms of participation that take place in the context of professional development on-line. (Cole, 1998)

As the use of email or other forms of electronic communication grows as a method of professional development research has been conducted in a variety of areas. Existing research on teacher-to-teacher electronic communication has focused on diverse topics including the reasons teachers used the network at particular times (West et al., 1989); the professional ties fostered by the network (Broholm and Aust, 1994; Stahlhut & Hawkes, 1994); the number, content, and writing style of messages posted by individuals (Weir, 1992; West et al., 1989); and the impact of participation on the professional lives of both active and passive participants (DiMauro and Jacobs, 1995; Jacobs and DiMauro, 1995). No matter what the focus of the research all work points out that individual teachers participated in different ways. However, these differing forms of participation are rarely described systematically. The goal of the work reported here was to begin to develop a means of carefully describing on-line participation in a professional development setting.

The work focused on the Elementary School Mathematics Project (ESMP), part of MATHLINE, a project of the Public Broadcasting System (PBS). ESMP has two components: a set of lessons presented on paper and video, and a system to link the participants electronically in a small group, a learning community, and throughout the country. This work was concerned only with the learning community on-line component.

To investigate forms of participation four representative learning communities were selected. All of the messages posted on each of the learning communities' electronic bulletin boards were collected for each of four weeks spread through the 1996-97 school year.

Close examination of the messages reveled three distinct types of messages, statements, inquires, and replies. A statement was defined as a message that makes a statement or tells a story. In a statement the author may present an opinion or may simply state facts. A message was classified as an inquiry if the purpose of the message was to seek information or to elicit a response. Replies were defined as messages in which it was clear that the message was prompted by another message. These message types were used as the basis for the development of categories of participation.

All of the messages collected were coded as one of the three message types or as a combination of two types. There were a total of 271 messages collected of which 24% were classified only as statements, 13% only as inquiries, 42% only as replies, 6% as both statements and inquiries, 10% as both statements and replies, and 5% as inquiries and replies. Once the messages were classified, they were sorted by participant in order to investigate the possibility of trends in participation. Some possible trends appeared and were used to identify seemingly different forms of participation or participation profiles. Previous work in the field (DiMauro and Jacobs, 1995; Jacobs and DiMauro, 1995; West et al., 1989) predicted two broad categories, active participation and passive participation. Jacobs and DiMauro (1995) had named one of the types of passive participation "active readers." These were participants who read almost all of the on-line communication but rarely, if ever, posted messages. These ideas of active and passive participation and active readers influenced the formation of the profiles in this work.

Once messages were sorted by participant, careful examination of each participant's messages took place in order to identify similarities and differences among participants. This examination suggested the existence of five distinct forms of participation, three passive and two active.

The first, and most easily identifiable form of participation was non-participant. These were participants who, while enrolled in the project, did not participate on-line. The second form of passive participation was the limited participants, these teachers read and posted messages infrequently. The exact definition of infrequent is difficult because in this data set there was no clear gap in terms of percentage of messages read or posted. The final form of passive participation was the form described in previous literature, the active reader. These participants read all or most of the messages posted to the network, but never posted their own messages or did so very infrequently.

There were two forms of active participation identified, informers and active participants. The informers were perhaps the most unexpected profile. These participants read and posted actively, but all of the messages they posted were either statements or replies. This group never posed inquiries always dispensing rather than seeking information. This was surprising since previous literature suggested that teachers participate in on-line communities in order to get answers to their questions (Broholm and Aust, 1994; West et al., 1989), clearly these teachers participated for other reasons.

The final form of active participation was named the active participants. These teachers read all or almost all of the messages posted and contributed regularly to the on-line conversation using all three message types. These were the people who kept the network going. In the data examined all of the people identified as on-line facilitators fell into this category as did others.

While it is difficult to develop exact definitions in this preliminary work with a limited data set, some reasoned decisions were made about cut-off points in order to classify each participant into one of the five styles of participation. When this was complete for the particular data set from MATHLINE, 12% of the participants fell into the non-participant category, 24% in the limited participant category, 29% active readers, 12% informers, and 23% active participants.

While it is clear that further work is required to verify and further refine the profiles identified, the participants in each profile were examined to investigate possible connections between the profiles and other factors. It was found that the most active participants were also the most experienced teachers with the active participants having a mean of 24.6 years of teaching experience while the next most experienced group were the active readers with a mean of 17.3 years. Almost all of the participants listed highlights of participating in ESMP, but the highlights varied with the level of participation. Those with limited on-line participation named the lessons as highlights while the highlights for those who were more active were mixed. There was no connection between the level of on-line participation and the grade taught or the amount of professional development in the year prior to the ESMP project. Finally, active participants tended to have access to the system at home (44.4%) or both at home and at school (44.4%) rather than only at school (11.2%).

The results of the study provide a beginning in developing a means of describing what happens in on-line professional development projects for teachers. The profiles should be verified and then further explored. While this study is preliminary, there are some recommendations or considerations possible from the results.

First, organizers should expect differing forms of on-line participation. Providing lessons, as MATHLINE did, or other materials may be important in keeping those with differing on-line participation engaged in the process. In addition, if possible, efforts should be made to make the on-line component accessible to teachers in their homes. While this does not guarantee participation, it appears to contribute. Finally, effort should be made to include teachers with a variety of levels of experience and not to exclude interested, experienced teachers who in this case were the majority of the active participants.

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Computer Mediated Communication: Instructional Concerns in the College of Education and Health Professions, the University of Arkansas
(A dissertation proposal submitted in partial fulfillment of the requirements for the degree of Doctor of Education)

Ana Martinez
University of Arkansas
Graduate Education Building 102
Fayetteville, Arkansas USA
martinez@comp.uark.edu

Introduction

We are living in the emergence of the Information Age. Telecommunications and networked systems are becoming bigger and more functional. The Internet is considered the world's largest computer network and community of computer users. The Web, as the Internet is commonly known, provides cheap and simple access to a fast-growing, global information service, for both providers and consumers of information (Ford, 1995).

Most of the recent literature published about technology in the classroom refers to the highest profile element of the Internet, the World Wide Web. Faculties are involved in practices using the Web as an information resource or as a way to communicate with others. The use of e-mail and the World Wide Web in education is part of the daily activity in most of the colleges and universities. Educators have developed special classroom activities and collaborative projects using electronic media. Electronic information access and retrieval, e-mail, Bulletin Boards (BBSs), and Computer Conferencing are some of the possibilities of Computer Mediated Communication (CMC) that are effecting education daily.

Certainly, colleges and universities are particularly conducive to computer network use. Professors are invited to use or re-invent the use of the medium as they wish. However there has been resistance to many educational innovations introduced in the higher education over the years. Some educators possibly view CMC as another innovation that will come and go (Cuban, 1986). Nevertheless, the diffusion of an innovation and its use will depend on its acceptance among innovators and early adopters (Rogers, 1995).

Computer Mediated Communication is being implemented in the College of Education and Health Professions at the University of Arkansas. Most of the professors search the web daily and are using e-mail as a way to communicate with their students. However, little or no research regarding the concerns of faculties related to the utilization of CMC have been done.

Research Design

The purpose of this study is to determine the level of concerns among professors who use or do not use CMC for instruction in the College of Education and Health Professions at the University of Arkansas. Survey methodology was selected as the method of investigation. A questionnaire, Stages of Concern ©(SoCQ), developed by Hall G. E., and Hord, S.M in Texas Research and Development Center, was selected to gather data on demographics and levels of concerns among the teaching faculty at the College of Education and Health Professions at the University of Arkansas in Fayetteville, AR. The College of Education and Health Professions at the University of Arkansas was founded in 1934. It is located in the northwest part of Arkansas in Fayetteville. The target population for the study will be the entire teaching faculty at the College of Education and Health Professions at the University of Arkansas. The research questions are:

1. What are the stages of concern among professors who are using or not using CMC on instruction?
2. To what extent do stages of concern among the professors vary according to age, rank and by departments?

Instrumentation

The instrument will be sent through the campus mail to the entire teaching faculty during the Spring Semester 1999. Descriptive statistics will be used for all variables. The resulting descriptive statistics will include frequency distributions and percentages. For the SoC questionnaire, raw scores for each of the seven sub-scales will be tallied and converted to norm percentiles for each of those seven categories. Also, stages of concerns will be combined and analyzed by departments, age, and academic rank. The chi square test of association will be used to determine the significant difference among independent groups.

Results

This is an ongoing research project. Data will be collected during Spring Semester. In June, all the data will be collected and analysis will be completed.

Implications and Conclusion

As a result of the information age tool (i.e., the Internet) in school, innovative educational activities are growing. Opportune questions regarding the cognitive and social benefits of new interactions must be raised. Also questions about how educators concern about technology in school. This research suggests that change in teaching practice is based on the teachers' practices and believes (Richardson, 1990). It is important to consider the control that teachers have over change. Studies that are more comprehensive might take into consideration the nature of CMC, the way it has been used, the instructional context, and so on. Further research might look for the variability of these findings across other colleges of education.

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Internet as a Learning Tool: A Look at Adults' Self-Directed Learning on the Web

Renee' Cambiano
University of Arkansas
Graduate Education Building 102
Fayetteville, Arkansas USA
rcambia@comp.uark.edu

Rhonda Harvey
University of Arkansas
Graduate Education Building 101
Fayetteville, Arkansas USA
rharv@comp.uark.edu

Ana Beatriz Martinez
University of Arkansas
Graduate Education Building 102
Fayetteville, Arkansas USA
martinez@comp.uark.edu

Introduction

Aging is a natural phenomenon that refers to "changes that occur during the lifespan and result in differences in structure and function between the youthful generation and the elder generation, but these processes do not occur at a given age or set time in all individuals" (Kennedy, 1992 p. 10). The ability to learn and acquire knowledge does not end at the onset of old age. Rather, the focus of learning in adults changes from curiosity to a need to learn to function in society, solve problems, and to grow as an individual.

As we approach the twenty-first century, there is a need for the older adult population to acquire knowledge and compete with the younger generations. With the onset of new technologies, millions of older adults are learning to use the Internet (World Wide Web). Older adults are gaining Internet skills that are becoming a common aspect of life, yet few of these older adults have had formal instruction on how to navigate the web. The majority of them rely on self-directed learning and informal knowledge (Cahoon, 1998). According to Knowles (1980), self-directed learning is only one facet of adult learning. Knowles states that adults are: (a) motivated to learn, (b) pragmatic learners, (c) self-directed learners, and (d) they struggle to balance learning projects against the constraints of time, space, economic resources, and personal relationship. In fact, self-direction is a familiar characteristic of adult learning that is important for the acquisition of basic Internet skills and for successful participation in Internet-based distance learning (Cahoon, 1998).

Older adults are drawn to the new communicative channels of e-mail, on-line conferencing, and Web publishing because of its convenience. However, frustration and isolation can be found by the lack of familiar social cues when working in on-line environments. Older adults are facing the need to learn and at the same time, they have to deal with the demands of adult life. The Internet is becoming a demanding instructional tool among older adults because of the availability and flexibility of Internet resources. According to Grodsky and Gilbert (1998), "older adults are not moving slowly and cautiously, but are racing into the computer age" (p. 70).

In the past, combining older adults and computers seemed impossible. Now, with seniors returning to the workforce, contacting family and friends via e-mail, exploring new worlds through the Internet, or just the seniors increased ability to expand and gain new knowledge are defining new boundaries for the older adult learning environment (Spiezle, 1999). According to Kennedy (1992), "humans maintain an intellectual curiosity about the natural world throughout the lifespan" (p. 11). Therefore, it is important to encourage older adults to explore the avenues of new technology and to have access to the world of the Internet.

Many older adults are experiencing the Internet through a national non-profit organization called SeniorNet. SeniorNet is dedicated to "making sure that seniors are not left by the side of the road on the Information Superhighway"(Grodsky & Gilbert, 1998 p.72). SeniorNet has been enhancing older adults' knowledge about computer technology since 1986. SeniorNet not only has a Web page dedicated to older adult learning, but also the organization has established 128 learning centers in 35 states where adults over 50 years old can participate in classes ranging from introduction to computers to developing their own Web page. Amazingly enough, the key to the success of the SeniorNet classes is that the classes are peer taught (Grodsky & Gilbert, 1998).

Methodology

A survey was developed by the researchers to collect information pertaining to how and why adults 50 and older are learning on the Internet. A Web page was then developed containing the survey (see Appendix A). The URL address (http://www.infopoll.com/infopoll/surveys/s3253.htm) of the survey and a short description of the purpose of the survey was then sent to Marcie Schwarz, SeniorNet Director of Education. She added a link to access the survey from the SeniorNet Web page in March, 1999. This is an ongoing research project. Data will be collected once a month to ensure that people are still accessing the survey. The SeniorNet population will have access to the survey for an entire year. In March, 2000, all the data will be collected, and analysis will be completed.

Implications and Conclusion

Knowing how and why adults 50 years and older are accessing the Internet to learn can be beneficial in several ways. First of all, knowing this information allows higher education and senior organizations to participate in the changing environment of the Internet users and provide methods of lifelong learning opportunities to the aging population. This will in turn provide a chance "to deliver services that will upgrade the social, economic, educational, and personal conditions of the older adult population" (Swift, 1986 p. 19).

Imagining the future, there will be more access to on-line learning in the form of courses, distance learning, computer-based learning, and Web-based learning environments. Educators can take this information gained from this survey and incorporate it into curriculum for older adults learning in both informal and formal situations. Since the next century will be shaped by technology, it is important to understand learning on the Internet of all users (Cahoon, 1998).

Looking into the future, there is one thing for certain; the Internet will only continue to evolve, and that technology will continue to create learning opportunities for the older adult. The number of older adults using the Internet will continue to grow as access to personal computers becomes easier and programs become more user friendly. Society should not underestimate the abilities of the older adult population and how important it is to the older adult population to keep up with societal and technological changes.

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Uncoupling Content in a Team Approach to Educational Multimedia Development

Trevor Doerksen
University of Calgary
Canada
doerksen@ucalgary.ca

Introduction

Due to the relatively easy use of the tools involved in developing educational multimedia, an individual could be Subject Matter Expert, graphic artist, computer programmer, and Instructional Designer on a project that they manage and distribute themselves. This method has been referred to as the "Lone Ranger and Tonto" approach by Tony Bates of the University of British Columbia (Bates, 1995). According to Bates this system, with the "Lone Ranger" as faculty member and "Tonto" as graduate student is not sustainable over time. An uncoupled content and team approach to educational multimedia development may lead to more applicable, more cost-effective, and more re-usable educational multimedia.

Team Approach

The team approach requires collaborative authoring of educational multimedia. The methods, approaches, and tools in collaborative authoring vary (Dobson, 1993). At the University of Calgary, collaborative authoring involves Instructional Designers, professors, multimedia professionals, students, and other Subject Matter Experts. The initial collaboration is often between Subject Matter Experts (SME) and Instructional Designer.

What is the best way that Subject Matter Experts can contribute to authoring the educational multimedia, recognizing that in many settings the best way is a balance between efficiency, cost effectiveness, and simplicity and accurate, innovative, and effective educational multimedia? This paper will suggest a process of collaborative authoring in educational multimedia development. The author is currently conducting research attempting to find out how best Subject Matter Experts contribute in the educational multimedia development process, in order to understand how to build sustainable, flexible, and applicable media.

Consider the following methods for dealing with content in educational multimedia:

1. *Teach* Subject Matter Experts multimedia and instructional design
2. *Teach* subject matter to Instructional Designer.
3. ***Team*** Subject Matter Experts with Instructional Designers

The first two methods listed above have had various levels of success, but importantly they can be considered less sustainable and applicable overall (Bates, 1995). As we develop skills, methods, and processes as specialists in the various disciplines in educational multimedia development we move towards a sustainable, cost effective, and innovative production system. The final approach from above when combined with uncoupled content holds promise for developing more high quality educational multimedia better and faster.

Uncoupling the Content

Recently, the University of Calgary's Advanced Media for Learning, has implemented a design process that separates the content from the engine that drives the educational media (Figure 1). By taking the content out of the programming environment we achieved shortened development cycles; and sustainable, versionable, reusable, and applicable educational multimedia and multimedia components. Importantly, the model also gives the authorship of multimedia to Subject Matter Experts and lends to collaborative authoring.

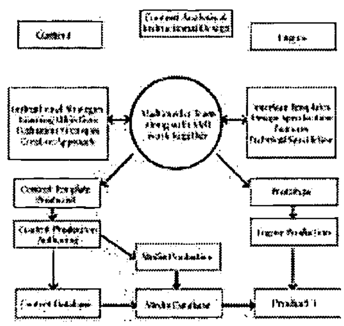

Figure 1. Uncoupled Content Model. The model demonstrates the separation of content from the engine, concurrent development, collaborative content authorship, and integration of content and media at run-time.

A team approach combined with uncoupling the content from the programming environment allows authors of multimedia to be Subject Matter Experts, the graphic artists to produce graphics, the computer programmer to focus on the programming, etc. And if the uncoupled content is stored in a consistent manner, e.g. a database, the assembly of educational multimedia is executed at run-time by drawing the appropriate information from content and media databases. With the content separated from the engine, changing the content does not require changes to the programming, only to the content data store. To change the delivery platform of the content, one may only have to program a new engine; one does not have to re-write the content.

This approach basically eliminates the need for an individual to integrate and assemble the production. The uncoupled content model, as pictured in Figure 1, demonstrates the simultaneous processes that can occur, namely content production, engine production, and media production. These simultaneous events shorten development cycles and, importantly, lead to a more predictable development cycle. The process also enables Subject Matter Experts and Instructional Designers to collaborate effectively to structure and author content using a standard word processor. Making it possible for multiple authors, using the authoring templates, to provide content. This can help increase the *buy-in factor* among potential users increasing applicability and validity of the end product.

The real "authoring tool" of educational multimedia then becomes a word processor not Director®, or Authorware®. Subject Matter Experts don't have to learn new tools, and software to produce educational multimedia for their classroom. Of course, they can if they want and there is plenty of software and support available. But on larger projects that could apply to multiple situations, a team approach that uncouples the content from the multimedia engine is beneficial.

Conclusion

Decreasing development times, increasing applicability, reusability and versionability have been realized through an uncoupled and team approach to multimedia development. This paper partially describes a process that is currently undergoing further study. The lack of metrics available to measure outputs will likely force the research to take the form of a case study. Some of the preliminary observations of the case study, following the production of a 4 CD-ROM set titled, "A Practical Guide to Communication Skills in Clinical Practice" will be presented at ED-Media '99.

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The Effectiveness of an Electronically-Based Curriculum to Enhance Student Learning in a University Level Introductory Kinesiology Course

Nancy Knop, Ph.D.
Dept. of Exercise & Nutritional Sciences
San Diego State University, USA
knop@mail.sdsu.edu

Kathryn LaMaster, Ph.D.
Dept. of Exercise & Nutritional Sciences
San Diego State University, USA
lamaster@mail.sdsu.edu

Introduction

With the development of technology capable of enhancing communication through electronic media, universities and schools are rapidly being encouraged to take advantage of these advances to both enhance instruction and to provide educative opportunities to people previously prohibited from instruction because of spatial, financial, or time constraints (Gordon, H., 1996). Consistent with these national and international trends, San Diego State University has a recent history of encouraging faculty to re-envision what post-secondary education looks like through the use of the multiple technologies available on campus. For the first time last year one Exercise and Nutrition Sciences introductory class was offered completely on-line. The questions that this raises, particularly in a content area based on physical performances of various sorts and geared toward human interaction (like most health professions), are what are students learning and how is the learning enhanced or limited by the electronic media. The purpose, then of this study was to document the interactions students had with the introductory kinesiology course content generated by the instructor via electronic media. A further purpose was to document the interactive changes the instructor made in response to student feedback in an effort to make the class engaging and challenging for all learners.

Methods

All of the approximate 150 students enrolled in the introductory course were invited to be participants in the study. Qualitative methods (Bogdan & Biklen, 1992) were used to document learning and describe the learning processes of students throughout the study. Data sources included student work, teacher response to student interaction, and unstructured interviews of the current course instructor, graduate assistant, and students.

Student work was documented using student assignments, electronic journals in response to queries by the instructor about perceived problem issues, and grades. The timeliness, completeness, and depth of student work was used to document on-going student learning. Teacher response to student interaction was documented through e-mail interaction, in-class interaction, and phone calls. E-mail interaction was documented by archiving e-mails by the date they arrived. In-class interaction and phone calls were documented by a weekly log of interactions kept by the instructor that include the content or technological issue at the heart of the interaction. Teacher response to student interaction documented by any change the teacher makes with the class in response to students was documented by additional information posted on WWW and additional e-mail information or queries.

Student interviews occurred based on their technology and course content interest. After the first test, students were grouped by their performance on the content knowledge. Students who fell into the A, B, C, D, and failure assessment regions were provided the opportunity to participate in the study. One or two students participating in the study and randomly selected from each grade level served as the interview respondents after the midterm and final. Toward the end of the semester, several students representing the five grade assessments were assembled for a focus group interview (Fontana and Frey, 1994) to determine critical issues important to learning in the class.

Data Analysis

Student work, teacher generated documents, transcribed interviews, and teacher notes were analyzed using document analysis (Marshall & Rossman, 1995). To organize analysis of these documents, the theoretical perspectives and methodological approaches of structuralism were enlisted. Structuralism views "documents" as "texts" (Manning & Cullum-Swan, 1994, p. 467). As such, once the data is accumulated in written form, it was read through several times. With each reading a set of tentative themes was developed and refined. The emerging themes and issues arising from the readings created the codes or interpretive frames that guided and structured the analysis. Trends and commonalties informed researcher understandings of students' perceptions of the internet based course.

Data was organized chronologically to observe for trends. Within the chronological patterns that emerged, data was further organized into similar themes and categories. Rossman and Rallis (1998) suggest that once data has been coded into categories, themes, and patterns researchers have to "challenge the very pattern that seemed so apparent" (p. 181). To do this, once themes emerged within the chronology, negative cases or cases that did not fit the emerging trends were sought. Further, the trends across the chronology were compared to document how the context impacted the data. For instance, if some pedagogical decision were followed by trends in student response, this chronological trend was tracked across the chronology of the semester to see if similar trends existed. The credibility of data generated under qualitative research is determined by a network of methodological and analytical issues that focused on "establishing the match between the constructed realities of stakeholders and those realities as represented by the evaluator and attributed to various stakeholders" (Guba & Lincoln, 1989, p. 237). Three methodological issues that added to the study credibility are the length of engagement, the persistence of observation, and triangulation of data from multiple sources.

The results of this study add to the collective knowledge of distance learning and to what we know about student socialization into fitness, nutrition, and education disciplines. In addition, the efficacy of learning based on teacher/course expectations and actual learning were documented. It is further intended to support changes in on-line course design and presentation by describing the process students engage in to learn the necessary content. Data documented both the process of learning, the complexities of technologically based resources and how the process of accessing information enhances or limits student content learning and discovery.

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The Integration of Classroom and Web-based Teaching: Utilizing technology to provide the best of both worlds for adult learners

Frances Dolloph
Shepherd College
United States
fdolloph@shepherd.wvnet.edu

The purpose of this paper is to describe the development of a college course for rural adults in principles of marketing that utilized both distance education and class meetings.

Faculty Support

Many adults know they need to upgrade their skills, but need encouragement and personal recognition to do so. In the past, regular class meetings have provided the opportunity for the teacher to provide this support and encouragement. In many rural settings, students and families are new owners of computers and neophytes at using the Internet. They often need assistance with using the Internet as a means of course work and resource while at the same time learning the subject matter.

Utilization of Student Time

Adult learners who are employed full-time often cannot attend classes on a daily or even weekly basis. When the instructor posts course work including assignments, readings, notes, and web sites on the Internet, students can access these materials at their convenience. By utilizing e-mail for the transmission of homework and questions to the teacher, the teacher can respond in a timely manner without having to wait for the class to meet. In addition, regular postings of homework assignments help to keep each student focused and moving forward. Using the Internet as a means of communication between groups and partners avoids extra travel or time off from work.

Utilization of Class Time

While some people may be able to work alone at home at the computer, most careers today involve personal interaction with others. In addition, not all courses or teaching styles lend themselves to total web presentation. Scheduling class time for teacher presentations, group discussions, student presentations, and exams provides face-to-face opportunities for learning and interaction. Utilizing technology to communicate with students saves valuable class time for subject matter discussions and the presentation of original materials not available in the text. Students come to class prepared having sent homework assignments via e-mail several days prior to the scheduled class meeting. By utilizing the Internet students receive individual attention and acquire group skills.

Class Description

During the fall 1998 semester, a totally web-based course was changed to include several class meetings. None of the students were proficient in the use of the Internet and e-mail, therefore time was allowed for orientation to the Internet as a resource and as a medium for learning. This is a very small rural branch of a small college where the only technical assistance available is from the instructor. Class time was used for exams, instruction in presentation skills, and class discussions of readings and assignments. Individual and group presentations of projects were completed in person.

Teaching Goals and Objectives

This course was developed for the rural adult learner, degree or non-degree seeking student. Behavioral goals included helping adults to achieve a positive attitude toward life-long learning and technology, and increased self-identity through the development of individual potential. Instructional goals included knowledge about the Internet and its application to marketing, the preparation and presentation of marketing plans, and the understanding of the specific objectives associated with marketing concepts.

Summary

By the midpoint of the course students were regularly sending assignments to the instructor via e-mail without difficulty. Assignments that included searching the Internet were well done and thoughtfully completed. Utilization of class time was very focused. Students expressed concern that the course took a lot of work and were reminded of the time saved by not driving to and attending some classes. Presentations and projects were completed in a professional manner. Responses to the students by the instructor needed to be better planned. This format was a good alternative to totally web-based courses, it allowed for personal interaction among students and teacher while encouraging students to use new technology.

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Implementing Online Discussions for Guided Reflections.

Kathryn LaMaster, Ph.D.
Dept. of Exercise & Nutritional Sciences
San Diego State University, USA
lamaster@mail.sdsu.edu

Debra Bayles Martin, Ph.D.
School of Teacher Education
San Dicgo Statc Univcrsity, USA
bayles@mail.sdsu.edu

Stacy Vinge
Valley Elementary School
Graduate Student, San Diego State University, USA
travelleur@aol.com

Since Schon's (1983) work on the reflective practitioner, the teacher education literature has featured numerous calls for teachers (both pre- and inservice) to reflect upon their teaching as a way to take control of their personal professional development and their teaching success (Vogt & Au, 1995). Educators believe reflection should be encouraged, however, there is less clarity regarding how that process best occurs. This is especially true when it comes to the use of technology in encouraging personal reflection.

While the use of technology has been discussed as a supplement to instruction (Poling, 1994), a unique form of communication (Eiser, 1990), and a provider of new information sources (e.g., web sites), (Chandler & Maddux, 1998), these concepts are not without their drawbacks. Providing computer access for students is frequently cited as a major cause of frustration with students participating in e-mail oriented projects (Tannehill, Berkowitz & LaMaster, 1997). Helping students gain ease and familiarity with the technology is another challenge in implementing technology-based education procedures, requiring time for students to gain confidence in their computer skills (Delcourt & Kinzie, 1993).

A recent pilot study (Bayles Martin & LaMaster, in process) confirmed the roadblocks of technology access and familiarity in a graduate education course. Based upon findings of a pilot study conducted in 1997-98, the following research question was used to guide this study: How can a selected group of reading graduate students most ably use technology to support and enhance their reflection about teaching? It is the thesis of this project that students must be given time and support to develop the facility to reflect on their practice in various contexts and that this support can and should extend to use of technology in the reflection process.

Methodology

This study involves a semester of graduate student preparation in technology. During the previous study, it was determined that students' overt expression of reflection rarely surfaced without specific and explicit interaction by the course instructors. In other words, when asked simply to "reflect" about their teaching on email, students rarely did so. It was difficult to determine whether students were less reflective than expected, or whether technology challenges artificially truncated student responses.

To address issues of technology access and familiarity, graduate students in an education reading assessment course were introduced to email and listserv communication through weekly case study analysis. Students' ability to express their personal reflections and consider reflexive issues (beyond their classrooms) were also supported through the use of personal dialogue journals and weekly professional article response papers. Both of these activities involved more traditional communication means (paper and pencil; word processing) so that students' learning about reflection was not confounded with their familiarity with electronic communication.

The subjects for this study were 22 graduate students enrolled in a Reading/Language Arts Master's program and participating in a clinical reading experience. During clinics graduate students worked in small groups and individually with learners experiencing difficulty with reading. All subjects had campus access to e-mail accounts and computers through the university or their professional sites. Participants were assigned to the same listserv. The primary researchers and a graduate assistant were also included on the lists to monitor and provide guided reflection. At least once a week, participants posted to their class lists reflections to the case studies posted by the instructor. Peers read and responded to each others postings. All participants were urged to maintain communication with their peers through the e-mail class lists.

Analysis

Two goals directed the data analysis: 1) to identify the kinds of reflection graduate students engage in throughout the study; and 2) to determine whether graduate student reflections change throughout the semester;. A grounded theory approach was used for data analysis of electronic forum entries and other related artifacts (Strauss & Corbin, 1990). Forum entries were read and reread by researchers and categorized by themes. Because this study will span 16 weeks, opportunities for triangulation (Lincoln & Guba, 1985) will occur naturally and vary over time. For example, as students articulate concerns and reflections in email addresses, their actual clinical teaching can be observed for congruence with their comments. On-line member-checking will occur whenever instructors provide electronic (or verbal) feedback to students.

Implications from this study are best articulated as potential benefits to the profession. First among these is the opportunity to gain further insight into the reflective processes of teacher educators during an intensive and supervised course and field experience. A second benefit involves the exploration of the role of technology in facilitating (or impeding) attempts first at reflection, and second at guided reflection. A third benefit accrues from the opportunity to observe participants' actual instruction at the Reading Center to see whether (or how) various reflections and guided reflections are enacted with Center clients.

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Pedagogy Reflections: Teaching a Web Based Course

Kathryn LaMaster, Ph.D.
Dept. of Exercise & Nutritional Sciences
San Diego State University, USA
lamaster@mail.sdsu.edu

Nancy Knop, Ph.D.
Dept. of Exercise & Nutritional Sciences
San Diego State University, USA
knop@mail.sdsu.edu

Courses delivered on the Internet provide "convenience to learners both in terms of time and freedom of space" (Schlough & Bhuripanyo, 1998). In their study of a course delivered on the Internet students were surveyed in an effort to identify advantages, disadvantages, and suggestions concerning asynchronous course delivery. Beyond convenience, advantages included learners accessing and reading course materials at their own pace and richness of materials through linkages to other sites. Weaknesses of this style of instructional delivery included students having to be self-disciplined, the instructional style was not appropriate for all learners, and some course sections were confusing to use. Suggestions included establishing a chat room for learner support, improvements in the site, provide a printed version of the text, and more in-depth orientation to the course.

As the use of Internet based instruction continues to develop it will be important to examine the issues associated with this style of learning. Studies concerning instruction on the Internet have examined the student's perspective (Mory, Gambill, & Browning, 1998), provided suggestions concerning course development, technical issues (Schuttloffel, 1998), and interaction guidelines. However, studies that examine and question pedagogical concerns are not as evident.

San Diego State University has encouraged faculty to re-envision what post-secondary education looks like through the use of the multiple technologies. In response to the campus wide interests, the Department of Exercise and Nutritional Sciences changed their introductory kinesiology course from traditional learning to asynchronous learning, using the Internet. The purpose of this study was to examine and explore various pedagogical concerns from the perspective of the introductory course instructor. The results of this study will add to the collective knowledge of Web based instruction methods. It is further intended to support changes in on-line course design and presentation by describing the pedagogical issues of concern to the instructor.

Methodology

This research study was designed to examine pedagogical issues associated with a Web based course. Introduction to Kinesiology is a required course taken by all students entering the department. Course information is designed to expose students to the department, faculty, campus, and potential careers through a series of lectures, assignments, and projects. Information for the course (syllabus, lecture notes, assignments, announcements, etc.) were organized through designed web links to individual parts of the course. There were two weekly course meeting times where the instructor was available, but no on-campus student attendance was required. Communication between students and instructor could occur through class session, e-mail, telephone, and office hours.

The subject for this study was the instructor for the Web based course taught to approximate 200 undergraduate students. This instructor was very familiar with pedagogical strategies, but had not designed the Internet course. It was the first semester that the subject had taught the course. Throughout the first several weeks of the semester the subject kept notes of pedagogical concerns and reflections. After the first few weeks the subject engaged in several informal interviews with the researcher. Both the subject and researcher kept notes, journals, and created further questions aimed at probing certain pedagogical topics identified by the subject.

Data Analysis

Qualitative methods (Bogdan & Biklen, 1992) were used to document and describe the process of identifying pedagogical concerns. Data sources included subject and researcher notes, journals, and reflections. Researcher and teacher generated documents and interviews were analyzed using document analysis. To organize analysis of these documents, the theoretical perspectives and methodological approaches of structuralism were enlisted. Structuralism views "documents" as "texts" (Manning & Cullum-Swan, 1994, p. 467). As such, once the data was accumulated in written form, it was read through several times. With each reading a set of tentative themes was developed and refined. The emerging themes and issues arising from the readings created the codes or interpretive frames that guided and structured the analysis.

Results

Several pedagogical issues emerged throughout this investigation including course content, testing, and communication. The subject identified concerns with the depth and breadth of lecture notes on the web sites. The question arose, how to provide focus and content emphasis for students. Many of the instructor reflections were directly impacted by feedback from the students. Student feedback was obtained through anonymous comment mailforms, e-mail message questions, questions asked during class sessions, and phone messages.

Developing an environment conducive to testing was another great concern for this instructor. Issues of honesty and integrity were an important concern, but was not overshadowed by location and proctoring problems. All of the exams were to be taken using a computer. In past semesters students were able to attend an open lab, show identification and take the exam at their convenience. This previous arrangement was not available during the semester that the study took place and resulted in several time management issues for the instructor and students.

Providing quality communication with students was another theme which emerged throughout the study. The course used e-mail, provided two weekly one hours sessions where the instructor was available, and instructor office hours. These strategies seemed to be sufficient, yet students were constantly phoning and visiting the instructor outside of these prescribed times. Previously identified suggestions for instructors of Internet courses include "don't be available to your students all the time" (Boettcher, 1997). Results from this study indicated that further examination of this web based course should occur.

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WEB ASSISTED LANGUAGE LEARNING

Beverley J. Clinch
Department of Education
Edith Cowan University, Perth, Western Australia
bev1@concentric.net

Abstract: The purpose of this paper is to illustrate the incorporation of the World Wide Web into Spanish pedagogy at a local high school in South Carolina. This on-going project fits within the communicative emphasis on language learning. The open-ended nature of hypertext imposes an active role in the learning process which motivates the individual, crosses curriculum boundaries, and improves basic skills. Such an environment provides students an ability to "learn language, learn about language and through language". (Warschauer, 1997). However, what level or quality of *learning* actually occurs as a result? In examination, this paper provides preliminary findings and theoretical support.

WALL

"For every hour of instruction, there are 34 hours spent in the wilderness".

(McCarthy, 1992).

As a teacher in rural South Carolina, I facilitate the learning-process of my high school students through the implementation of a web page project in their Spanish class. Assigned cultural topics, these students become so absorbed in the work, that they are unaware of the skills being utilized, the cognitive thinking levels used to complete the task, or the hours of time given outside regular class meetings. This paper examines Web Assisted Language Learning (WALL) in the context of these on-going student projects with the primary foci being the effectiveness of the learning that takes place.

Based on theoretical principles laid out by cognitive researchers there is support for effective student learning facilitated by these projects. "Effective learning involves a desire on the part of the learner to grapple with and understand material in order to carry out higher cognitive functions."(Koppi, 1997). In other words the enticement of the learner to take a deeper, more internalized approach to his/her learning.

Traditionally, language learning has been viewed as a process of acquiring language skills, and evaluation has been seen in terms of achievement. "On-line language learning, however, is a different process. The educational objectives should not be defined behaviorally. Language learning on the Internet is more similar to painting, singing a chorus, or playing a ball game." (Kojiro, 1997) WALL therefore is more in keeping with John Dewey who recognized the need for more "cultural" education, one that combines theory and practice, to help create more well rounded, intelligent, and adaptable citizens. (Dewey, 1964).

Like a word processor a student engages his/her mind to comply with active learning. Engaged are his/her thoughts, imagination, emotions, and preconceptions as he/she formulates understanding of new information. (Caine, 1994). To examine the vast array of information the student encounters WALL requires this processor to operate at a higher cognitive level. As a tool, WALL has potential to implement student reflection, evaluation, organization, analyzation, creativity, comparative thinking, and information discovery which combine to encourage students to learn and to construct their own meanings regarding the assigned topic. This multiplicity of higher order thinking skills are automatically used as the processor sifts new information. In the words of "Plato and Aristotle, truth does not seep into the mind, but rather is discovered through thought and inquiry."(Harlow & Johnson, 1998). These web pages "enable students to create different maps or models, and to explore multiple answers". (Ervin & Baldwin, 1997).

If one changes the tools of thinking available to a child, his mind will have a radically different structure.

(Vygotsky, 1978)

Vygotsky lends credence to WALL and these hypertext projects, particularly in the development of holistic theories of language learning. Vygotsky places language learning as a forerunner to thought, asserting that only language use will cause the higher mental processes to become operational. (Zepp, 1989). Language is viewed as a tool used by the learner in social interaction resulting in the achievement of higher cognitive processes. Vygotsky's *zone of proximal development* encompasses "the distance between actual developmental level ... and the potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." (Vygotsky, 1978). During these projects the Web is used as the tool of social interaction between student and learning, and, at the same time, encourages students to go beyond their current skill and knowledge levels. Given specific topics, students explore the Web in search of data. This requires them to read for a specific purpose, evaluate the authenticity of data, compare different view points, analyze and synthesize diverse sources of information, and construct their own understanding of the topic by creating their own web pages. Bruner explores the implications of tutoring and guided learning through his notion of "scaffolding"—step-by-step assisted learning until gradually gaining independence (Bruner, 1986). The active-learner goes beyond the information provided by internalizing the information, and constructing new ideas and concepts. The learning that takes place with these projects is student-directed. Each student makes choices and takes the responsibility for those choices thereby resulting in more meaningful learning (Dunlap, 1998) "In general, material that is organized in terms of a person's own interests and cognitive structures is material that has the best chance of being accessible in memory."(Bruner, 1961) Likewise Summers (1995) points out that when students are acquiring and evaluating on-line information found on the web, students gain extensive reading practice and make use of complex comprehension and analysis skills. Students employ strategies such as scanning to retrieve information. Despite unknown vocabulary structures students are motivated to decode text in the target language thereby extending their knowledge. Additionally, the Web offers language students multiple modalities through combined text, sound and visuals. "Visual stimuli can become memory-assisting devices" (Stickels & Schwartz, 1987).

The hypertext documents created by my students exemplify cognitive learning and use of critical thinking. Located at http://members.tripod.com/~clinch1, these web pages demonstrate the comprehension of information, organization of ideas, analysis of data, application of knowledge, synthesis into their written document and evaluation of ideas. Within the cognitive domain identified by Bloom (knowledge, comprehension, application, analysis, synthesis, evaluation) this project provides the opportunity for students to develop and to effectively use these skills.

The student produced web page project is an embodiment of teaching students how to learn.... Not what to think or how to regurgitate facts. But how do we assess this learning?

Literature is lacking in viable instruments for measuring hypertext learning, (Ryser, 1996), particularly in foreign language acquisition. "When students exchange e-mail with their peers from different cultures and create web pages, their interest is directed to the content" (Ervin, 1997) rather than the grammatical structures of the traditional classroom experience. WALL enables the language learner to learn in actual context as well as from each other. (Kojiro, 1997). My students are observed to ask questions of each other, aid each other, and collaborate together as they seek to achieve success in their projects. Instructional and educational activities assume new meaning. No longer is a paper written just as a course requirement, read just for a grade, but rather in the context of authentic communication read by "real" readers.

Bearing this in mind, there are a number of research studies assessing the effects of computer technology in the classroom. According to a study by McKinnon, Nolan and Sinclair (1996) in New Zealand, computer usage enabled students to not just become technologically literate, but also to become producers of knowledge as they analyzed data and information. (McKinnon, 1996). The study noted that within a given learning activity there was a broader cooperation among individuals, more spontaneous interest, an expansion of time and attention devoted to the activity, and a stimulus for developing the research spirit. Like examples have been observed in my classroom. These high school students willingly assist each other in the process of the web page creation, from simple data retrieval, cut and paste activities to HTML writing. Hours of extra time are dedicated to the activity, during lunch and after school. They even get-together at the homes of friends connected to the Internet to continue working. The search for more extensive information was exemplified by a student researching human rights issues in various South American countries----"How can these things happen? Why?....This is just so interesting, I'll just read a bit more, I'm almost through"-----an hour passed without noticing that lunch was missed.

Another study by Liu and Rutledge (1997) in Texas ascertain the same quality learning, motivation, and time on task. "Students began to exert pressure on those who tended to neglect the project.... students reminded each other not the teacher". Results of this study suggest that web page design is a motivation to learn, and program development for "real" audiences provide its impetus. Their research also revealed student exercise of higher order thinking skills such as project management, research, organization and presentation.

Further credibility to student independence, motivation, critical thinking was made in a 1997 comparative study in 7 urban school districts within the United States. (Follansbee). "Students who had access to on-line use not only were able to identify and articulate a problem more clearly, but also were more informed and had projects that were more compelling." (Chavez, 1998). This study concluded that the Internet can increase learning.

Personal web pages can be expressions of a students own ideas, thereby promoting ownership of the learning environment according to Kapur & Stillman (1997). Their study provides evidence of improved quality learning as well as enhanced levels of student satisfaction. Case studies indicate that Web supported learning causes a significant learning curve according to Gillham, Buckner & Butt (1998). Favorable student attitudes and motivational benefits are also provided by Keeler, 1996; Hill & Smith 1998; Forrester, 1995 to name a few.

All of these studies lend support to the observed behavior and learning outcomes of my students.

Learning in the hypermedia environment of the Web is a complex and dynamic interacting process, yet research provides no definitive answers to the "learning" that actually takes place with each student. I can only attest to the learning that I have observed in my classroom. My students thrive and interact with the Web as they embrace their Spanish projects. It is a key to improved learning in my language classroom. Within a structured activity, WALL is a tool to be capitalized upon by language instructors to improve learning. These activities are not just "cool" and "fun" but provide for "real learning" in a "real" world. Linguistic skills are strengthened, peer interaction-collaboration is established, while at the same time learning about contemporary culture and everyday life in the target country is maintained. (Standards, 1996; SC Frameworks, 1994). My analysis of WALL and stimulated "learning" continues as further activities are implemented and a qualitative study is undertaken.

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Technology and Urban, Elementary School Reform

James M. Laffey
Linda Espinosa
Dale Musser
Center for Technology Innovations in Education
University of Missouri-Columbia
jim@coe.missouri.edu

The Panel on Educational Technology of the President's Committee of Advisors on Science and Technology (PCAST) summarized its findings about the state of technology in K-12 education as follows: "During a period in which technology has fundamentally transformed America's offices, factories, and retail establishments, however, its impact within our nation's classrooms has generally been quite modest." (PCAST, 1997 p. 6) When measured against the promise of educational technology the use and impact of technology in schools is small, and even less so in elementary schools. PCAST recognized the potential of technology to support fundamental changes in pedagogic models moving toward a more "contructivist" paradigm. In reality, however, computers are used primarily for learning about computers (keyboarding) and software applications (word processing, databases, and spreadsheets). In elementary schools computers are primarily used for practicing isolated basic skills and for playing educational games.

The Jefferson School Project focuses on implementing technology to bring about school improvement in an elementary school in an impoverished urban community. The framework for the project starts with a model of education that can be improved through the use of technology. The goal of the project is to (1) transform the school facility and culture from a factory model of isolated, and sequenced production units to a networked knowledge center of an involved community, (2) build instructional practices that embody a concept of the child as a constructor of knowledge, (3) improve the learning outcomes of children, and (4) understand the potential of technology and appropriate development methods for achieving goals 1, 2 & 3.

The Jefferson School Project is a collaboration among the Center for Technology Innovations in Education of the University of Missouri (CTIE); McCormack, Baron & Associates, a nationally recognized leader in community and housing development, Southwestern Bell, the Danforth Foundation, and the St. Louis Public School Board. The children of Jefferson School are in need of significantly improved educational opportunities. They live in an impoverished community and attend a school with low achievement test scores. The climate of the school is characterized by a high emphasis on control (e.g., silence during lunchtime); whole class instruction, drill and practice of isolated skills, and a faculty who felt left behind as the school district invested its few resources in magnet schools at other locations.

Rapid and dramatic changes are planned for the Jefferson School and community. A new principal was hired to lead the staff. The Danforth Foundation has committed $200,000 for professional development over a two-year period. Southwestern Bell has committed approximately $ .75 million to create an exceptional networking capacity for the school and has provided support for CTIE to assist the principal and community in planning reform efforts for the school in ways that take advantage of technology. McCormack, Baron & Associates is developing new low-cost housing for the community and is providing leadership and initiative to reform the school to serve the community, including efforts to fund the purchase of new computers for school and adult-learning objectives. In effect, the project is an emergence of an elementary school that will have great technological capacity and serve at-risk minority children and their community.

Most efforts to use technology in elementary education use technology to deliver computer assisted instruction. We agree that elementary education is a process of helping children develop the knowledge and skills that are the foundation of citizenry and competency in our society. In addition, however, during their pre-kindergarten and elementary school years children form important self-concepts and build habits of mind that lead to a social, intellectual, and economic destiny. Development of the young child is shaped by the social relationships formed with parents, other children, and teachers. The knowledge and skills that children develop are constructed in the context of these important social relations. The role of technology is not to replace these relationships as it builds skills, but rather to support, extend, and amplify the social relationships and levers they provide for early education. New and advancing technology can play this role through augmenting educational processes that are fundamental to early education and that have potential for significant improvement.

Technology can play this role by:
- Enriching experiences though visualization, simulation and other forms of mediation,
- Supporting active learning and individualization in the classroom,
- Making all members of the process more resourceful, and
- Implementing new and powerful forms of communication, sharing, and coordination for the children, teachers, parents, and extended members of the community (school board and administration, university partners, employers, etc.).

During the Summer of 1998 a new principal was hired, an advanced network installation and other facilities improvements were undertaken, a professional development plan was created for the faculty, and an initial workshop was held to develop a vision statement and build awareness about the use of active learning and technology in instruction. The key form of professional development is to get the faculty engaged in active learning with technology, and providing opportunities and support for reflection on those practices, so as to drive new models of instruction with their children.

During the school year of '98-'99 the following activities are underway:
(a) workshops for teachers focused on technology, project based learning, and safe schools (Nine day long sessions to be held on Saturdays as per the request of the teachers),
(b) placing two computers in each classroom with a goal of having at least 6 per class.
(c) having network services come on-line (including email and web servers)
(d) grade-level teacher teams that will implement interdisciplinary, technology-rich projects, on the theme of "community",
(e) teacher teams becoming engaged in the decision-making of the school improvement efforts, and
(f) individual support for teachers as they try new teaching approaches and use new technology in their classrooms.

Along with these work efforts to implement a technology infrastructure for the school, change instructional practices, and improve learning, we are documenting and studying the processes of implementation and socialization. Research methods include multiple interviews with all teachers and other key participants, systematic classroom observations of teaching and learning practices, records of learning outcomes, patterns of technology usage, and analysis of artifacts from teacher and student use of technology.

Early findings suggest several key themes:
(a) Irresistible technology meets immovable bureaucracy - the realities of large school districts often mitigate against rapid innovation.
(b) Through learning about technology, teachers can begin to feel and understand the power of hands-on, individualization and support, and then contrast this approach with traditional teacher telling and classroom seatwork.
(c) Through learning with technology, teachers can begin to feel the power of multi-media representation, networked resources and learner initiation.
(d) Network and media technologies are engaging for children and adults.
(e) True curriculum change will be a long process.

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MOVING TO THE WEB USING ELF POWER

Don Sheridan
Director, Business Education On-Line
School of Business and Economics
The University of Auckland
Private Bag 92019
Auckland, New Zealand
Email: d.sheridan@auckland.ac.nz

1. Introduction

The University of Auckland with an enrolment of 26 000 students shares with other tertiary educational institutions the vision of providing life-long learning for its students while attempting to deal with the current restraints on budget and a lack of progress toward optimal use of technology in teaching and learning.

The School of Business and Economics at the University of Auckland has developed a computer-supported learning system (CSL *aka* Cecil) that is now in its fourth year of operation and delivers browser-based assessments and other learning materials to tens of thousands of students in business and the sciences. On a weekly basis Cecil generates many thousand unique practice sessions and quizzes, sends out hundreds of diagnostic email messages and at times is processing more than 300 transactions per second. The work of developing Cecil and designing it for life long learning has been reported earlier at EdMedia conferences (Sheridan, 1997 & 1998)

In this paper we report on our efforts to move the curriculum content of a large business school onto the web-environment, as provided by Cecil, using as a guide the model provided by the University of Tennessee (Little & Derco, 1998). The principle actors in this success were Extroverted Learning Facilitators (ELFs) an idea derived from (Holt, 1997). This paper will outline the process, achievements, problems and current state of play.

2. The ITC Model

The Innovative Technologies Center, University of Tennessee provides a practical model for moving an institution toward broadly based web courses (Little & Derco, 1998). The four phases include: general information, augmentation, stand alone instructional pieces, and totally on-line.

Phase I: General Information
syllabus, course calendar, bibliography, communications (email), last date updated
Phase II: Augmentation
expanded course calendar, expanded bibliography, announcements, lecture notes, grades, glossary, communications
Phase III: Stand Alone Instructional Pieces
All of the earlier phases plus, tutorials, self-assessments, skills survey, communications (threaded discussions, chat, MOO/MUD)
Phase IV: Totally Online
All of the earlier phases and no face to face, student biographies and introductions, class photos, course authentication, online testing

This model does not prevent individuals from forging ahead, but it does give managers and administrators some achievable targets at the early stages of online development. Given the inevitable fiscal constraints then the question arises: How to get the existing materials converted and online.

3. The ELF

Course development for web based delivery poses a significant problem if the only people available are fully tasked academics. It seemed reasonable to adopt a model implemented at Athabasca University where students worked on course conversion, design and development with positive results. (Holt, 1997) It was noted that students often have a clear vision of what their peers would want in a learner centered environment and they also see the possibilities of the technology in achieving it.

In our instance we employed nine summer students across seven departments. We sought out students to become Extroverted Learning Facilitators (ELFs). The characteristics we needed were principally students who were in the honours or masters program of each department, and at the same time, enthusiastic about their discipline and technology in general. Their infectious enthusiasm would carry the day and allow us to pull the necessary information and knowledge from academics to ensure we could push the school to Phase II within three months.

The ELF worked principally in a designated department. Training was provided on the Cecil interface, Microsoft Office 97 to HTML conversion, simple HTML authoring and editing skills, document conversion to Adobe Acrobat, Lotus ScreenCam production, and document scanning and editing using Adobe Photoshop.

4. The Results

Over the summer recess, the ELFs exceeded our expectations by persuading even the most reluctant academics to participate. In meeting the Phase I and II objectives we now have 871 papers on line with total enrolment of 27,000+ students. More than 240 staff are using the Cecil Explorer (interface). Staff training was designed and carried out by the ELFs. A CD was also produced with learning materials better suited to off-line access. These included HTML documents, Office 97 and Acrobat files, software applications, browser updates, and a video and audio segment. The Dean and department heads were so impressed with the results they decided to extend part-time employment to the ELFs for the next academic year. ELFs are now providing individualised assistance to their staff as well as working the Cecil help desk for the benefit of all the academic community.

Cecil system provides a central focus for the integrity of course content by storing learning resources within its database. Cecil is a multi-tiered computer architecture. The database, SQL7.0, located on a multiprocessor Sequent NT has grown to 8GB in only a few months. The dual, fault tolerant, front-end computers are the internet servers and process approximately 3M hits per week. It has become a 7 day 24 hour operation. (www.cecil.edu)

While Cecil is being used a repository for learning materials, it is really an instructional management and assessment system. At this point, only a few academics have created personal bodies of knowledge (BoK) on their desktops and replicated portions of the BoKs across to the major Cecil site. More progress is expected on this front as the academics come to understand the significance of this feature since the goal is to provide a shared BoK that resides, in part, on the academic's desktop, the university's Cecil system, and a student's laptop. Collaboration among peers whether they be academics or students will result in dramatic changes in the way knowledge is created, shared, and managed.

This an on-going project. Phase I & II was for many academics a hint of the new frontier. An update will be provided at the EdMedia 99 conference.

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The Learning Web: A Technical Evaluation of WebCT in Concurrent Classroom and Distance Education Sections of a Software Engineering Graduate Course

Niek J.E. Wijngaards, D. Michele Jacobsen, Rob Kremer, & Mildred L.G. Shaw
Department of Computer Science, University of Calgary
{niek, jacobsen, kremer, mildred} @cpsc.ucalgary.ca
http://sern.ucalgary.ca/

Introduction

The Software Engineering Research Network (SERN) is funded by industry and administered by the Industrial Software Engineering Chair at the University of Calgary to support the dissemination of good practice in software engineering. One component of SERN's activities is a thesis-based masters program with a specialization in software engineering targeted at students with industrial experience in full-time employment (Shaw & Gaines, 1998). This program has dual objectives: to develop highly qualified personnel, and to encourage industry-based software engineering research with a focus on good practice. Coursework includes requirements that have been developed in consultation with the industry partners. The learning environment is unconventional and reflects the industrial experience of the students. After the first lecture in a required course, students take on much of the responsibility for presentations on the various topics that draw upon their experience and that of their colleagues. The instructors' role is that of facilitator, "guide on the side", managing a process of debate and exploration rather than attempting to be the "sage on the stage" authority in the domain.

The overall aim of the masters program is to provide a supportive and nurturing learning environment in which experience and knowledge can be shared and created, and errors and omissions made without censure but with ready access to diagnostic help. Student assignments are submitted on the World Wide Web making them accessible to others. A list server is used for continuing discussion of the course topics outside the class environment. These two features have made it possible for students whose companies allocate them to work in other locations, or who change jobs to companies in other locations world-wide, to continue to participate in the courses. Remote students who have already come to know their colleagues can continue to present and share material through the web and participate in discussion through the list server. It becomes clear to students as they progress through the program that, while there are no easy answers to the core questions of industrial practice in software engineering, there are many useful perspectives and that simplistic answers generally have very limited applicability.

We are currently addressing the challenge of making our graduate program formally available and accessible to students who want to participate from a distance. A first step has been to develop and offer parallel sections of SENG 611, a six-week graduate course in Requirements Engineering. One section of SENG 611 was delivered on campus, and the other delivered at a distance using facilities provided by WebCT. Of the 21 students in the course, 7 chose to participate in the distance section, and 14 on campus in a conventional face-to-face learning environment. In addition to individual assignments, all students completed a major group project that was presented during the final lecture. The on-campus students recorded and summarized classroom discussions that were posted on the Web for the distance students.

WebCT and Technical Support for SENG 611

The technical support requirements for SENG 611 were concerned with two main issues: 1) supporting the organization and delivery of the course, and 2) minimizing the differences in student engagement. Although the course material already existed as web pages, WebCT was chosen as the web-based software tool to support the dissemination of course related information in this experiment (see Goldberg, Salari, & Swoboda, 1996). WebCT offered encapsulation and paths through the existing course content, student presentation areas for groups of students, individual student tools for note-taking, and a chat facility for synchronous, online discussions. It was the preferred choice for a number of reasons, including free testing of WebCT with full functionality at the University of Calgary, inexpensive licenses, a large customer base, proximity of developers, ease of access via common web-browsers, and ease of customization (if needed).

In Spring 1998, WebCT was installed on a local server so we could experiment with many of its features. This led to enough confidence in WebCT for its use with the graduate course in Fall 1998. The technical support person and a course instructor were well versed in HTML, scripting, and other computer-related activities which influenced the evaluation and usage of WebCT. Based on the current experiment using WebCT, we have made the following observations:

1. Support from developers of WebCT is very good. Queries and requests were dealt with quickly and to our satisfaction.
2. It is easy to (a) install WebCT (beta 1.3 on Windows NT took slightly more time than 1.2 on Unix), (b) create courses as an administrator, and (c) encapsulate existing course material.
3. It is moderately difficult to get used to all of the WebCT concepts and to develop a mental map of the course structures, and to keep information up-to-date in a course, because the tool imposes a certain approach to structuring on-line course materials. One must become familiar with the affordances and constraints inherent in WebCT's design in order to construct well-organized course materials.
4. It was difficult to customize WebCT to add connections to the external list server; Perl scripts had to be modified to add a mailto: hyperlink (referring to the list server) to WebCT's common button bar.

WebCT is geared to non-technical course designers; faculty with little or no prior experience with HTML will find the inherent structure and design of WebCT to be useful starting points. However, it was our experience that the WebCT designer interface often hampered the HTML-knowledgeable instructor's efficiency in building and maintaining the course material. For example, sequencing course materials requires the designer to set up a "path", which involves a number of intermediate steps that would not be required if the designer was using only HTML. However, for an instructor who is new to creating web-based documents, the structure and tool set offered by WebCT provide valuable entry-level supports and templates as they construct course materials.

We found that WebCT was not completely applicable to the current offering of the SENG 611 course. However, based upon research that compared WebCT to other web-based course tools (e.g., Kristapiazzi, 1998), we expect that other web-based course tools are also not completely applicable and would require customization for SENG courses. Courses in the research-based M.Sc. program have been developed within an open architecture philosophy and the belief that there should be public access to past and present SENG course materials and student work. Inherent to the design of WebCT is a closed architecture philosophy -- courses are password protected, and information in courses is not easily accessible to the general public.

WebCT's student tools, in particular note making and group presentation areas, offer useful tools for online courses. The e-mail and chat facilities in WebCT were not used for the current experiment; an external, publicly accessible list server remained in use. WebCT's quizzes, which employ selected response and open-ended questions, and so on, were not useful for this graduate-level course. However, we did employ these features in the service of a midterm examination for a large undergraduate course (CPSC 533) in Artificial Intelligence. We have found the online testing features of WebCT offer a reliable and useful environment for exams. In order to provide some practice with the WebCT exam environment prior to the midterm, we required students to login, change their password, and complete a short, pre-exam survey. In this way, those students who experienced difficulties had an opportunity to seek assistance before attempting the online midterm exam. Our findings, in brief: students were frustrated with a) the time clock feature, which only updates when an answer is submitted, thus giving a false impression about time left to complete, and b) having to submit each answer individually rather than the entire completed exam.

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Using Technology in the Delivery of Teacher Education Courses

Dr. Teresa Yohon, School of Education, Colorado State University, USA Email: **yohon@cahs.colostate.edu**

Problem

Colorado business and marketing education programs face a state of emergency due to the shortage of qualified teachers. A qualified teacher is one who has completed a teacher licensure program and vocational credentialing courses in business or marketing. According to personnel at Colorado's Department of Education, approximately 60 positions will be opened next year in business and marketing, while only 20 to 25 new teachers will be licensed and credentialed in business and marketing education for the 1999-2000 school year.

Because of the shortage of qualified business and marketing teachers, secondary schools are requesting--in record numbers--emergency credentials for instructors so they will be able to teach in a business or marketing classroom while they go back to school for needed coursework. The majority of teachers on emergency credentials are licensed teachers from other disciplines, teachers from other states, or business people who have become teachers. Currently 44 business and marketing teachers across Colorado need between four to ten credit hours to be certified in business and/or marketing education. With the number of retiring business teachers increasing and the small number of new teachers being licensed and credentialed, emergency credentialing of teachers soon will become the norm instead of the exception.

One barrier in Colorado to the credentialing of marketing and business teachers is the availability of credentialing courses. Only Colorado State University (CSU) can offer these required credentialing courses. Some courses are offered only once or twice a year. In most cases, students must attend classes at CSU's main campus, a hardship on the students because of long driving distances in Colorado

The shortage of business and marketing teachers is further acerbated by the current delivery structure of teacher licensure courses. Most students wishing to become a business or marketing teacher already have completed their bachelors' degree in business. These preservice teachers need about 34 credits in education coursework to obtain a teacher license, plus eight to twelve credits in vocational education to obtain a vocational credential. The current arrangement of courses at CSU dictates an investment by the preservice teachers of at least a year and a half of full-time study, during which time it is difficult to maintain a job to support themselves and their families.

Project in Progress

To meet this need, Colorado State University has begun to turn to technology in the delivery of vocational credentialing and teacher education courses. A combination of face-to-face interaction (through the use of seminar-like sessions) and online learning will be used. For the online learning piece, CSU's School of Education will use WebCT for learning module coordination, online testing, threaded discussions, chat rooms, email, and bulletin boards. The inclusion of distance learning via digital satellite will be available as a teaching methodology sometime during Fall 1999 through CSU's partnering with the Agricultural Distance Extension Consortium.

The first phase of this project will be to bring online the graduate-level methods courses in business and marketing education which are used in credentialing. During Fall 1999, the undergraduate methods courses in business and marketing, and the other credentialing courses will be placed online. During 2000, approximately four teacher licensure courses (still to be finalized by the teacher licensure committee) will be coverted to include heavy (but appropriate) levels of online activity. Possible teacher licensure courses to go online are Schooling in the United States, Educational Psychology, and parts of Classroom Management and Classroom Technology.

This project allows new teachers, especially those entering the educational field from industry or from another teaching area, to gain the knowledge and skills necessary for success in the classroom in a timely, but quality-based manner. In addition, the potential teacher could remain employed for a longer period of time while acquiring the skills and content needed to teach.

Data Available at the Time of Publication

Several areas already have been researched: (1) the technological capabilities that are available and which ones will be used (described briefly in the section above), (2) standard format for online credentialing courses, (3) the topics that should be covered in credentialing courses, and (4) what linkages should be made between the Colorado Department of Education (CDE), Colorado Community College and Occupational Educational System (CCCOES), "expert" teachers, and business people.

Online credentialing courses will assume one of two formats. Format 1 uses ten to fifteen hours of face-to-face time at the beginning of the course, with the remainder of the course to be completely online. Format 2 also has the majority of educational time online, but will utilize face-to-face seminars once a month, to cover the more delicate educational issues. With both formats, guest speakers will either be present during the face-to-face meetings or available during assigned chat times. Students will share projects, either during the seminars or online. Collaborative learning environments will be developed, utilizing WebCT's ability to aid inquiry-based learning through bulletin broads, email, and web site posting. Philosophically, the educational theory that will underpin the building of these courses is pragmatism and constuctivism (Miller 1996).

In preparation for online delivery of credentialing courses, research was conducted to determine the salient topics that should be included. According to (Lynch, Smith, & Rojewski 1994), the major educational reform themes that should be addressed in secondary vocational education include secondary/postsecondary institution linkages, equal access and opportunity for all students, flexible/alternative delivery systems, support services and funding, curriculum redesign, business-education partnerships, alternative assessment techniques, world class standards and assessment, and on-the-job training models. According to a 1999 survey conducted by myself with Colorado business and marketing teachers who have taught three years or less, the areas where additional training is needed are: the integration of vocational student organizations into the curriculum, funding sources for student and school projects, recruitment of students, marketing of their vocational program, and classroom management. Obviously, a marriage will need to be made between reform themes, which may not be first on a new teacher's "need to know" list, and the practical needs identified in the 1999 survey.

Four graduate courses have been converted to an online format and will be offered during the 1999 summer session. These courses are: Methods in Vocational Marketing Education, Programs in Vocational Marketing Education, Management of Business and Office Departments, and Organization of Business and Office Education. The topics identified above have been integrated into these courses, along with the areas of technology in the classroom, Colorado Standards, and career preparation and development.

Linkages have been established with CDE and CCCOES. Representatives from both agencies have reviewed the content for the graduate-level methods of business and marketing education courses (phase one). Suggested topics for inclusion were: integration of academic and vocational education; evaluation tools for employers, students, and follow-up; program approval; professional organizations; and support systems for new instructors. Staff from both agencies will participate as guest speakers. A survey is out now in regard to linkages that could be established with expert teachers. Business linkages will be established through expert teachers.

Additional Data to be Available at the Conference

At the time of the conference, module outlines for business and marketing education and other credentialing courses will be available. Specific issues as orientation to an online course, building collaboration online, using threaded discussion and chat, and evaluation of online courses will be discussed. Field test comments on two or three courses will be available. Expert teachers' participation level will be identified.

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Web Instruction to Promote Successful Inclusion of Limited English Proficient Learning Disabled Students

Lanna Andrews, Ed.D.
School of Education
University of San Francisco
USA
Andrews@usfca.edu

Two growing factors in today's classrooms, diversity and technology, are impacting teachers' ability to influence student growth (Grossman, 1995; Male, 1994). Even for prepared teachers, today's heterogeneous classrooms, with bilingual and disabled children, are a constant challenge. The information highway can benefit both students and teachers if the proper structures are in place (Male, 1994).

In California's urban schools, the challenge is paramount. The overwhelming majority of the students are from culturally and linguistically diverse backgrounds, and over ten percent of the students qualify for special education (Grossman, 1995). A typical classroom has several students for whom English is a second language and who have either learning disabilities or language disorders. It is difficult for a teacher to prepare interesting, appropriately adapted lessons for every child in her class six hours a day, 180 days a year.

Given the mandate to include all students in the general education classroom and to create a classroom climate that is an arena for goal-oriented, reflective problem solving (Laboratory of Comparative Human Cognition, 1989), schools need new technologies. An integrated curriculum is key to including all students (Sheppo et al, 1995). Multimedia technologies have significant potential for supporting an integrated and adaptive curriculum (Willis, 1992). Gardner (1993) argues that individual children need to be taught differently, because individuals understand the world in different ways. Gardner recommends that schools be filled with "apprenticeships, projects, and technologies" so that every kind of learner can be accommodated.

Telecommunications can open up vistas of new learning for students and expand collaboration between colleagues (Reinhardt, 1995). Teachers can interact and share ideas with colleagues and the interaction need not occur in "real time". The benefits, however, go far beyond simple communication. Databases can be developed which will be a resource for trying various methods and collaborate about their effectiveness.

The present project was created to: (1) use web instruction in a University teacher preparation program; (2) prepare student teachers to transfer learning from University classroom to school district classroom; and (3) provide a structure for student teachers and classroom teachers of mainstreamed learning disabled, limited English proficient students to collaborate about adapted lessons.

The ongoing project begins with student teachers in an urban general education teacher-training program by providing training during a required course, Teaching Exceptional Students. The instructor uses Web-CT software to develop a course website and place course components on the internet (agendas, requirements, activities, quizzes, discussion forums, and teaching cases). Students all have internet accounts provided by the University.

The on-line curriculum adaptation project requires a training phase. The training covers teaching students with learning disabilities, understanding stages of language acquisition with implication for instruction, strategies for adapting integrated lessons for disabled and limited English proficient students, and instruction regarding web site navigation. A long-term goal of the project is to develop an adapted curriculum database on the internet. In order to do this, student teachers are also given training regarding inputting lessons on a curriculum development tool placed on Web-CT. Once this training is complete, the student teachers form cooperative learning groups to begin applying their learning.

After the training phase, groups are given teaching cases that include written descriptions and the Individual Education Programs of actual special education limited English proficient students mainstreamed into an actual neighboring inner-city classroom (names are changed to provide confidentiality). Students then work together to examine previously written lessons designed for "typical" general education students and develop ideas for adapting lessons for these students using strategies for working with their learning disabilities and language comprehension needs. The cooperative learning groups then input adapted lessons in the web.

The project then goes one step further by conveniently putting the student teachers in touch with the actual classroom teacher of the students that have been studied. This is an advantage of using the internet far beyond the collection of a database. At her convenience, often at home late in the evening, the classroom teacher is able to access the curriculum development tool on the web and comment on the lesson and adaptations. The student teachers are then able to reflect on their adaptations and comment back to the classroom teachers, again on the internet. This dialogue provides real-life feedback and two-way communication.

The college instructor also accesses the lessons on the web and comments on the groups' work, giving immediate feedback. While this feedback is an effective teaching tool for the course, the responses from the classroom teacher prove to be the most helpful. Finally, the students revise their curriculum adaptations, based on the feedback.

The project is evaluated in three ways. Students complete course evaluations. In addition to this, they also respond to a survey instrument regarding attitudes about adapting curriculum and online instruction. But perhaps the most important evaluation is careful observation of the process from beginning to end, with special attention paid to the two-way feedback process.

Course evaluations regarding use of the curriculum development tool have been extremely positive, indicating that success relates to the structure of the tool itself, the teamwork involved, and the on-line feedback component. Additionally, student teachers self-report that they are using other students' adapted lessons, which are available on the internet.

Survey responses from participants in the first semester of the project were categorized into two general areas. There was a mean score of 4.4, somewhere between "agree" and "strongly agree," for all participants on the items focusing on perceived ability to adapt instruction, indicating that the project increased their ability to make curricular and instructional adaptations for differing student needs. The mean score for all participants on the items regarding the perceived effect of on-line collaboration and feedback with the classroom teacher was 4.0. This indicates agreement with the notion that the collaborative aspect of the project was a positive factor.

The results of the two-way feedback between the student teachers and the classroom teacher continually go beyond the project's original expectations. Each time groups receive feedback from the classroom teacher, usually in the form of questions, group members brainstorm and respond back in a more sophisticated manner. The case responses are not quantified, however, it is apparent to both the professor and the 5th grade teacher that the group responses to the on-line feedback demonstrate expanded reflection and adaptation ideas.

The implications for web instructional activities are far-reaching. This project shows that the convenience and speed of communication and collaboration on the web can enhance traditional teacher training. The skills that student teachers continue to develop during this ongoing project will contribute to the success of special education limited English proficient students in the mainstream.

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Issues in the Development of WWLab: A System for Scientific Experiments through the Web

Motoyuki SAISHO
Prefectural University of Kumamoto, 3-1-100, Tsukide, Kumamoto-shi, Japan
saisho@pu-kumamoto.ac.jp

Yutaka TSUTSUMI
Kyushu Teikyo Junior College
4-3-124, Shinkattati, Omuta-shi, Japan
yutaka@kyu-teikyo.ac.jp

Ryoji MATSUNO
Prefectural University of Kumamoto
3-1-100, Tsukide, Kumamoto-shi, Japan
matsuno@pu-kumamoto.ac.jp

1. Introduction

Recently, there are a lot of researches on real time online teaching. Until now, online teaching focused mainly on communicating from teachers to learners, that is to say, in one direction only. However, learners would deepen their understanding by performing themselves experiments in the field of science. Therefore, we proposed a scientific experiments system in which learners could operate experimental apparatus through the Web (Saisho et al. 1998). Moreover, we discussed issues in the development of WWLab (World Wide Laboratory) for scientific experiments. We classified scientific experiments in the following three groups, 1) Live experiments, 2) Web-based experiments, 3) Experiments by computer simulation.

This paper describes the classification of scientific experiments and what kinds of experiments were suitable for the system. We have a plan to apply the system for K4-K8 learners.

2. Outline of WWLab

WWLab, shown in Fig.1, consists of a web server machine, a video camera and experimental apparatus including a computer-controlled robot arm. A learner can see our Web page using an Internet Browser, such as Netscape Navigator and Internet Explorer. On the page, the learner can operate the experimental apparatus using controlling a robot arm. At the same time, the learner can see the state of the experiment by the video camera. The learner can also control the video camera on our Web page. Real time computer display of the experiment is observed simultaneously by other learners. And, the experimental process is recorded by means of the MPEG method on the server computer. And then, learners can replay the MPEG movie file on the Web.

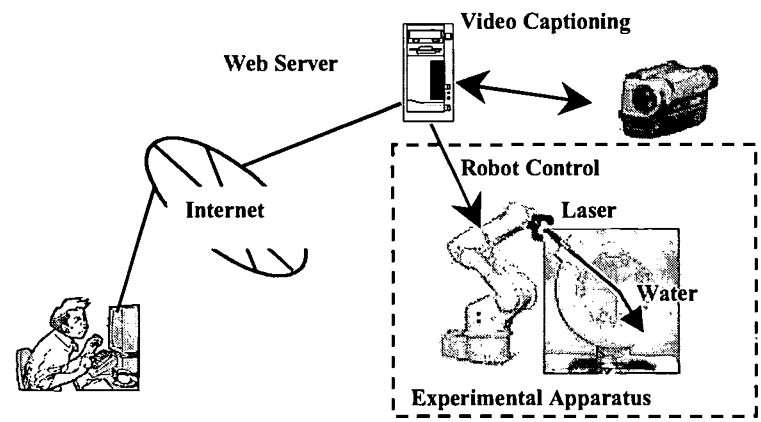

Fig.1 WWLab System

3. Advantages and aspects of WWLab

We will discuss advantages and aspects of WWLab that we have proposed. The advantages of the system are :

1. The result of the web-based experiment is not predictable because learners operate an experimental

apparatus by themselves although its operation is indirect.
2. Expensive experimental apparatus is made commonly available.
3. Even if an experiment may not go well, learners can have insight into a subject through failure.
4. Learners can collaborate with other on an experiment through the Web.
5. The system records experimental status in an MPEG file. Consequently, learners can repeatedly review the experiment.

There are a few problems of the system outlined below.
1. Learners do not have real experience because they can only operate experimental apparatus through the Web.
2. A robot arm carries out a learner's instructions. Therefore, this system is not suitable for precise experiments because the arm is not able to move with precision.
3. Though there are various methods for an experiment, this system is restricted to the experimental method which we have prepared.
4. A response to a learner's instruction is delayed when the network traffic is crowded.

4. Classification of experiments in online teaching

We classified experiments under the following three groups in order to discuss what kinds of experiments are suitable for WWLab.

1. Live experiments
   This group includes experiments in which learners are easily able to find necessary experimental apparatus in their own environment. Also, it includes experiments that are not suitable via the Web such as those concerning smell, taste and tactile sensation, as well as experiments that are influenced by the surroundings circumstances, e.g. temperature and humidity.
2. Web-based experiments
   This group includes experiments in which learners are not easily able to get experimental apparatus because it may be very expensive and specialized. Moreover, it includes experiments that are not influenced by the surroundings, e.g. time, place, temperature and humidity, as well as experiments which are limited by the requirement of a place such as a photographic darkroom and so on.
   There are two kinds of web-based experiment. These are experiments in which the parameters are fixed and experiments in which the parameters are freely set. The former has the advantage that learners can easily conduct experiments. The latter has the advantage that learners conduct experiments with their own ideas. However, in this case there is the possibility of having different results according to whoever conducted the experiment.
3. Experiments by computer simulation
   Suitable experiments in this group are those which would normally require much time to conduct. Computer simulation would decrease the experimental time. Also, it would be suitable for experiments where equipment is normally destroyed and costs would be very high. Moreover, there are other groups of experiments apart from 1 and 2, in which learners may wish to review 1 and 2.

5. Conclusion

In this paper, we discussed issues in the development of WWLab. We concluded experiments that require high accuracy and/or quick response are not suitable for WWLab. On the other hand, suitable are experiments that learners can not prepare experimental apparatus around them because of too expensive or special ones. We expect learners to develop positive creativeness and collaboration because they can conduct experiments and have communication with each other through the Web. In the future, we plan to develop other kinds of scientific experiments system and discuss problems of implementation in the system.

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Virtual Lectures Free Students to Think Critically

Harry R. Matthews
University of California,
Davis, CA 95616
hrmatthews@ucdavis.edu

Introduction

This paper is based on results from a pilot project now offered twice. The method depends on reconstructing lectures on the World Wide Web, to free up time for associated small group discussions. The distinguishing features of this approach include the use of virtual lectures to free the small groups from responsibility for content and the use of a comprehensive database that addresses all aspects of offering a course, with a focus on content organization and delivery (Matthews 1997a, 1991b, 1998).

Some university teachers espouse the lecture approach and some prefer the group discussion approach, of which problem-based learning is a subset. The strengths of lectures include an organized approach to the subject matter and a comprehensive coverage of topics deemed appropriate by the instructor. The strengths of discussions include better context and more active student involvement. Virtual lectures, now evolving into a virtual course, aim to combine the advantages of both approaches, to improve higher education.

The prototype course comprises twenty-three 50-minute lectures on Molecular & Cell Biology. The students, about 95 per class, are at the beginning of their first year in Medical School and come with a very wide range of backgrounds. They are intelligent and motivated to learn medicine but are not necessarily interested in molecular biology. The new approach was evaluated by comparing examination results with historical performance and by a detailed anonymous student questionnaire. The results show that factual and conceptual learning was at least as effective as with the traditional methods and that student acceptance was very high. Students believed their intellectual skills improved but this needs to be evaluated objectively and historically.

Ideas Behind the Course Design

Our students do well on our examinations and on those set by the National Board of Medical Examiners. Nevertheless, when they have completed their two years of basic science and move to the clinical environment they often feel that their basic science knowledge is irrelevant to clinical medicine and clinical instructors complain that the students lack basic science knowledge. More likely is that the students lack the ability to take material learned in one context and apply it in another and to take a general principle and apply it to a specific situation.

Many of our students learn very well visually and aurally. The computer has some advantages for this. First, students choose their own pace through the material as well as their own time and place for studying. Second, once the transformation to the computer was complete my time was freed up to focus on the development of the intellectual skills that I feel our students need badly.

Computer Techniques

The complete course content is now accessed exclusively through a web browser running on a personal computer. I have in-person office hours but students rarely use them. Students voluntarily attend the small-group discussions but these are oriented towards specific clinical cases that may or may not be germane to the topics in the virtual lectures.

The database integrates all aspects of a course, including course content, assignments, examinations and other components. The structure allows an instructor to select the parts (s)he wants to use and ignore the rest, which is then hidden from both instructor and student, until the instructor wants to extend the application. The course content is both structured and flexible accommodating many different types of multimedia. The multimedia files are distributed over additional Web servers and local CD-ROM drives while their display remains under the control of the central database. This architecture provides good performance under heavy load and over standard telephone lines.

The virtual lectures include animated graphics, sound and text. The format is flexible and modularized into the short topics so that each lecture can be easily edited and reorganized. The text is hyperlinked to a glossary and the lectures are linked to a bank of self-test questions also hyperlinked to the glossary. Additional tutorials, including video modules, and advanced topics, as well as readings and interactive 3-dimensional molecular models are integrated into the virtual course. Students have a personal notes page and preformatted email for asking questions by email. The course is available at http://trc.ucdavis.edu/coursepages/bcm410a/.

The database tracks and records key features of each student's use of the material and records the time and IP number for each logon. The time and IP number permit detailed analysis of the server log files and correlation with individual logons. This information shows objectively which components of the virtual course are most used, and, by comparing individual outcomes, which components are most effective as learning tools.

Measured Results

Examination results from the virtual offerings of BCM410A were better than from the face-to-face offerings although the students spent slightly less than the allotted time on each lecture. There are good textbooks in this field including my own (Matthews, Freedland & Meisfeld, 1997), but the students had an overwhelming preference for the virtual lectures. Anonymous student evaluations showed strong acceptance of the virtual lectures. The full evaluation results are available at http://trc.ucdavis.edu/coursepages/bcm410a/evaluations/.

Further Development

Three steps are proposed to make the success of the Web-plus-small-groups approach more widely available. First, objective evaluation tools will be developed to exploit the rich data in the database in order to determine how students used the virtual materials and how that relates to their outcomes. Evaluation will also be extended to better assess development of students' critical thinking skills and to include focus groups as well as anonymous surveys and analysis of objective data. Evaluation will exploit the existence of a closely related course that has been taught—more or less unchanged—together with the present course to the same students for more than 6 years, providing a control for each individual class. Second, the system will become "instructor-friendly", by providing flexible Web-based forms for interacting with the database for adding and organizing content and other information such as quizzes, examinations, assignments and student data. Third, the program will be used with another course, probably at the undergraduate level.

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Hypermedia Course Transformed: in-person to on-line Gains and Losses

Beva Eastman, Ph.D.
Educational Technology
New Jersey City University
beastman@njcu.edu

As the present culture becomes more and more graphic in information presentation, education now uses hypermedia to encourage students to acquire information and to construct knowledge. Teachers, trained in the traditional text methods, need to expand their teaching not only to include the new ways of presenting information using text, graphics, sound, and animation, but also to foster learning in a non-linear environment.

The Master of Arts in Educational Technology at New Jersey City University has as one of its required core courses: Hypermedia Across the Curriculum. This course up until Fall 1998 semester had always been taught in-person, because the many technological skills seemed too complicated to learn through an asynchronous course. However, in the Fall 1998 semester, the course was offered on-line. This paper will: a) discuss the differences between teaching/learning hypermedia in-person and on-line, b) preview the web site of the course to show how the hypermedia technological skills were transferred to the web medium, and c) assess the learning through specific examples created by the participants in the course.

BACKGROUND

Hypermedia is defined as multi-media technology controlled by and/or delivered through the computer. HyperStudio™ was the course software because of its non-linear capabilities, its availability on both platforms, and it is being used extensively in K-12 classrooms. The technical topics included manipulating graphics, sound, and text; cell and path animation; use of video, CD's, and Laserdiscs; scripting; and placing a stack on the web which required the use of the HyperStudio™ plug-in.

The students in the class were all educators: either teachers of a contained classroom or a particular curriculum area or computer coordinators who were responsible for more curriculum areas than just computer literacy. The course required that all technology be expressed within the participant's discipline which meant that all assignments were to be developed using the participant's curriculum.

All course materials were available on the web at the beginning of the course, so that more experienced participants could move around the course if they wished. All communication was done through private e-mail notes, public listserv notes, and through a public discussion forum. Participants, placed in groups of four, e-mailed their hypermedia assignments each week both to their group and to the instructor. The listserv became a place for technical help questions. The public discussion forum focused on different learning theories and/or the impact of a particular technological skill (such as cell animation) on learning.

DIFFERENCES IN ON-LINE AND IN-PERSON TEACHING/LEARNING

Because the on-line course was a first-time experiment, the differences discussed here are not the results of a formal study, but are anecdotal.

The first 20 minutes of an in-person class are always spent in a "show-and-tell" of the week's assignments with each stack being gently reviewed by everyone in the class. The on-line environment loses the class response to a stack and, what is extremely important, the class experience of the variety of stack design. However, the on-line environment, in which the instructor becomes a mentor to each individual participant through personal e-mail exchanges, does result in faster learning: more modification of stacks, more quickly.

On the other hand, non-hierarchical presentation of information was learned more slowly by participants in the on-line course. The simple use of a menu card to allow options needed to be addressed repeatedly in the on-line course, partly due to the fact that the web environment is not as flexible as a HyperStudio™ stack.

HYPERMEDIA WEB SITE

An on-line hypermedia course must demonstrate on its web site all of the technological capabilities that the software has. However, even simple transitions between cards are not possible yet on the web. Some of the graphic and text object manipulations could be done with static gifs, but all path and cell animation were translated to animated gifs. The section on sound and video used QuickTime movie format. But all of these examples are still presented linearly, which does not give a complete understanding of hypermedia. So, at some point in the course, everyone had to view completed stacks and hence use the HyperStudio™ plug-in.

The assignment which asked everyone to use the HyperStudio™ plug-in was designed as a "win-win" contest. The stack, to be viewed with the plug-in, was about a common plant with various clues. By identifying the correct name of the plant, every student could win, but only if they could view the stack! Although it was a course requirement to download, install, and use the HyperStudio™ plug-in, downloading the plug-in from a reputable commercial site was not something that everyone wanted to do because of past bad internet virus experiences. Installing and troubleshooting the installation added another level of technological frustration.

The most difficult technological assignment was the posting of a stack to the internet. This involved learning to "ftp" stacks to an anonymous ftp site, and creating a small HTML document. HyperStudio™ has a web page converter command to create the HTML code. However, since this code produced by the converter was not complete, a template code was placed on the web site that the participant could then copy, paste, and modify. But severe limitations exist with the HyperStudio™ plug-in. First, all techniques in HyperStudio™ stacks are not cross-platform, which leads to stacks crashing or simply not functioning correctly. Second, certain techniques are not possible to view with the plug-in. Last, size is essential!!! No compression is available for HyperStudio™. To view a stack larger than 500K real-time becomes an extremely time-consuming download!

ASSESSING THE LEARNING

Technological skills are easy to assess. A participant would send a stack with a path animation, and it could be easily seen whether or not the graphic did animate in a path. But, a course on hypermedia requires more than just a cluster of technological skills. The course offers the time to begin to look at presenting information in new ways. For example, HyperStudio™ has now added the dimension of direct links to the internet, which allows a stack to become the framework or context for viewing the variety of information on the internet.

One of the problems about an on-line course is that by not having the class conversation, an on-line student can move rapidly to fulfill the "tech" part of the course without participating fully in the discussions. How then, is such a student slowed down to begin to question and deepen his/her thinking beyond the technology? Not easily! The main way used in this course was through the instructor's e-mail exchange with each participant, by raising questions regarding the stack's information designed to focus the participant more fully on curriculum and methods of information presentation.

The final requirement for the course is to produce a curriculum-based extensive hypermedia project through which the participant's knowledge and understanding of hypermedia theory may be assessed. A comparative look at projects developed in an in-person course and in the on-line course will be briefly previewed in this presentation.

CONCLUSION

In comparing the on-line participants' portfolios to an in-person class's portfolios, the assignments and projects demonstrated quality similar to an in-person course. However, the level of frustration learning the technological skills at home alone seems to be higher than that in an in-person course. Also, the web site, which followed a previously designed syllabus for an in-person course, must be redesigned to incorporate more non-linear experience. The course focus, firmly grounded in the curriculum, gives the course its strong foundation, but a way to break the isolated learning of multiple technological skills in an on-line course must be found.

Integrating digital and classroom environments in the search for creative solutions to improve teaching/learning quality

Author: Garcia, Marilene (PhD) lena@anhembi.br
Affiliation: Universidade Anhembi-Morumbi - São Paulo - Brazil
Address: Rua Casa do Ator, 90 - ZIP CODE 04546-900
Phone numbers: 055 + 11+ 821 9020 / 055+11+280 8598 / 055+11+9112-7445

1. Introduction

This study main objective is to look for creative educational solutions to exploit Internet informational, communicative and research resources to improve classroom teaching quality. In order to do so, we had to invest in updating programs for our faculty and also in a program that guarantees the development of interactive and informational interfaces for classroom learning integrated with Internet/WWW. We are taking measures to improve the quality of educational strategies in our institution based on two projects:

Act-On-Line project, which, besides creating short-term on-line courses, develops interface and interactive design through Web-activities to integrate them in courses taught in the classroom.

PADO project, which develops programs (courses, workshops, didactic-technological counseling), aiming at updating university teachers on the use and exploitation of new technologies in higher education.

These two projects aim at the following goals:

- Invest in methodological research to create distant learning environments, emphasizing the exploitation of interactive tools for communication and information to give support to courses taught in the classroom.
- Stimulate faculty to create educational projects exploiting Internet resources: virtual experimental labs, expert systems of simulation, data banks of various formats (images, slides, graphics, etc.)
- Enable transference of different information through courses and interactive repositories available at WWW, in which the information being searched is driven by activities started in the classroom.
- Develop course methodologies and miscellaneous assessment processes, preferably exploiting Internet interactive tools.
- Practice formal and informal distant learning simultaneously.
- Assure participation and contribution of faculty members through their ideas to exploit Internet resources
- Research pedagogic effects related to WWW instructional interface

2. Internet/WWW environment solutions

For over a year, we created the Act-On-Line Project, which has two main objectives:

- Offer courses of recognized classroom acceptance in on-line format, aiming at reaching the public outside university campus in general. These are short-term courses, which last three months, in average, for continuous professional upgrading purposes. Presently we are on the Fourth Edition of these courses, working together with an interdisciplinary production team (Garcia, M & Maia, C. 1998).
- Create technological and didactic conditions to enable our professors to develop new routes between classroom classes and distant learning to get access to different contents and activities related to the subject taught within Internet/WWW environment.

Initially, we offered short-term courses aiming at researching environments and interfaces. We presently managed to implement two programs that combine classroom learning and distant learning through Internet. We use short-term courses and WWW activities of exercise and research.

Standards for developing mini-courses and Web-activities providing direct access interface and supporting tools for navigation and learning, which enable page reading, guided research to other pages outside the course/activity site, participation in discussion forums and chats, reposition of information in conjunction with other students, among others:

Interaction tools - direct access to permanent line e-mail, discussion forum opened to all participants, teacher's voice and help regarding interaction;

Learning tools: the course page itself, from which the content is accessed, external links for guided visit to sites of interest, suggestions for reading, glossary and help with the content;

Navigation tools: guide to the content and activities within the course;

Information tools: download, hot-links, bibliography and help on how to research in other sites of interest;

Educational contents shown in the program are basically of two natures:

- The ones that reflect course objectives;
- The ones that enable self-study
- The ones that enable deep discussion and exchange of ideas in the classroom.

Activities are prepared using multimedia elements, such as sound effects, animated images, besides text source. Another interesting aspect is the possibility offered to the students to discuss their difficulties with other participants in special forums, besides receiving answers via WWW page afterwards.The pedagogical goal is trying to assure a previous reflection and construction of arguments based on guided research to accomplish the activity.

3. Faculty updating program solution and steps

Universidade Anhembi Morumbi faculty-updating program has been created in order to assure that projects aiming at improving educational strategies quality through the use of new information and communication technologies would be implemented.

Initially, our goal was to get a teacher who had good performance in the classroom, take advantage of his/her motivation and didactic experience, and start the first attempts of technological and didactic updating.

Our goal is to check how faculty updating programs can be developed and implemented, aiming at general and specific goals and how to maintain and follow-up the teacher to help him/her achieve effective results in the classroom, creating conditions not only for technological updating but also for didactic and qualitative exploitation of WW/Internet for classroom work. This is an attempt to broaden the concept of distance education in WWW/Internet environment aimed at classroom work.

1. Program Phase:

At this phase we emphasized the use of Word to create handouts, exercises and tests, the use of Power Point to create presentations, as well as basic notions of hardware. Browser basic functions and fundamentals to surf and do research in Internet have also been explained. This step comprised 24 hours of classroom work.

2. Program Phase:

Deeper research notions, as well as exploitation of Internet communication resources. Basic principles to create html pages, which can be proposed in an educational site, have also been shown. This step comprised 24 hours of classroom work.

3. Program Phase:

How to create Web-activities and on-line courses. The course aims at preparing teachers to use Internet and produce classes, didactic contents, and activities for WWW environment. The course consists in three Workshops, each one of them working on a theme. First Workshop, theme: computer mediated teaching and learning

- Second Workshop, theme: course structure and on-line activities.
- Third Workshop, theme: tools to create on-line course

4. Conclusions

The goal of creating interactive and effective learning environments is the main purpose of these actions. Thus, it is our task to design educational products, within WWW context, involving data transmission interfaces and information that lead to the production of new knowledge from discussions and considerations made in the classroom.

The way of structuring data and information within WWW environment, aiming at knowledge, is directly related to the methodological organization that must comprise content transmission resources and create opportunity for interactions between learners and their facilitators.

Thus, our pedagogical model integrates educational interface development to the human potential that should exploit it. This potential is made of learners and facilitators of the process, who act both virtually, by accessing lists and discussion forums, and in the real world, when students are in the classroom.

The advantage of this pedagogical model can be noticed by the way through which teachers and learners effectively interact. We believe that the production of knowledge depends on people behind the interfaces developed.

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Using Computer-based Visual Mapping Tools to Enhance Pedagogical Practice.

Ian Brown & Brian Ferry
University of Wollongong, NSW Australia
ian_brown@uow.edu.au

Rationale

Visual mapping tools are computer-based and are essentially two dimensional and /or three dimensional spatial arrangements of text and diagrams. They have shown to help pre-service teachers to efficiently link curriculum content to instructional plans in Science and language contexts (Ferry 1996a, Ferry, 1996b, 1997; Novak and Gavin 1984; White and Gunstone 1992). This project attempted to enhance these findings by extending the process to another subject discipline, Visual Arts education. It was the researchers' belief that visual mapping tools could be used with other subject areas but difficulties may be experienced due to the unique nature of the particular subject discipline. For example, the reliance on visual representation in Visual Arts education may affect the efficient use of the tool. It was predicted that existing mapping tools may have to be redesigned or modified to enable for efficient use to occur. As a result of this project a number of significant results and areas for further study have started to emerge.

Aims of the Project/ Areas of Investigation

The initial aims of the research project was to compare the use of the computer mapping tool Inspiration® by pre-service teachers as they plan instruction in Science and Visual Arts education. A number of broad areas for exploration were developed and investigated by the researchers. For the purpose of this paper, the following specific questions will be addressed: Do computer based visual mapping tools assist or hinder pre-service teachers to organise curriculum content and knowledge to be effective instructors? When using computer based visual mapping tools to construct knowledge, do differences exist when applying subject matter knowledge in Science and Visual Arts education? Can the creative process in Visual Arts education be represented and deconstructed as a cognitive framework in the form of a visual map?

Methodology and Data Collection

During the research study twenty four volunteer pre-service teachers in their final year of elementary school teacher training were invited to: i. compare the use of the visual mapping tool Inspiration® to plan instruction in Science and Visual Arts education ii. analyse and deconstruct the creative process with the use of the visual mapping tool Inspiration® Data was collected through three main sources, ongoing written personal reflections, analysis of the visual maps produced and interviews. Interview transcripts, reflections and visual maps were coded and analysed for trends and emerging themes.

Brief Description of Study

Students were given four specific tasks to perform over a eight week period which involved both Science and Visual Arts education. They were: i. to plan a short program of work for an elementary class, using the visual mapping tool package Inspiration®, to conceptualise ideas and discipline specific knowledge ii. to research/investigate an artist/artwork, gathering as much information as possible in relation to lifestyle, historical background, media used and possible influences. iii. Students were required to construct a visual map of the information/knowledge gathered in (ii) conceptually, using the visual mapping tool Inspiration®. iv. plan the development of a personal creative response (artwork), using the visual mapping tool Inspiration® to conceptualise thoughts, ideas, materials and processes. Students were required to analyse their actions and thoughts, both positive and negative, through personal written reflections and interviews.

Preliminary Results and Emerging Themes

As a result of the analysis of preliminary data relating the areas of investigation (relating specifically to this paper) the following can be reported: All students agreed that the visual mapping tool package Inspiration® clearly assisted them with their organisation of curriculum content and knowledge. The students felt comfortable in a very short period of time in visually representing their knowledge and conceptualising in both subject disciplines. They commented that it provided a clearer way of thinking, it was more efficient which allowed the students choice in changing thoughts, conceptualising and recording their ideas. The students unanimously agreed that they would use the package again to prepare and plan their work. They believed that the visual mapping tools would enhance their abilities to be more effective instructors. These results are congruent with earlier studies conducted by Ferry 1996, 1997 and White and Gunstone 1992. Note: a number of criticisms/annoyances were raised by the students about specific actions relating to navigation which occurred when using the package. These points will be discussed in detail later in the paper.

From the interviews it can be concluded that the students felt that some differences were evident between the two disciplines when using the visual mapping tool package Inspiration®. Students generally commented that initially few differences occurred when planning instruction between the two disciplines, but when conceptualising knowledge, greater differences were apparent. This could be attributed to the nature of the task. In the Science area students were given a topic or concept from which the knowledge was drawn to develop the visual maps. While in one activity in the Visual Arts area, the students had to work in reverse, the concept was provided (the artwork development), then categories were constructed and developed.

From the visual maps provided by the pre-service students in this study and the analysis of the results it appears that the creative process can be represented and deconstructed as a cognitive framework in the form of a visual map. It is the researchers' belief that deconstruction or analysis of an artwork is a common practice in art education, but deconstruction using a visual mapping tool is a particularly unique phenomena. It is interesting to note from the results of the analysis of the visual maps, both the deconstruction of the artwork/artist and the construction of the personal response (artwork), is that it appears that the concept clusters developed by the pre-service students align closely to the New South Wales Visual Arts Years 7-12 syllabus framework for conceptual organisation, (a document that the students used in this study would not be familiar with). The conceptual organisation evident in the syllabus, includes areas such as structural, subjective and cultural, which was developed from postmodernist and deconstructionist theories.

Conclusion and future directions

This paper has only addressed a small area of the total research project. Other areas presently under investigation and proposed for future research include: the relationship between learning styles and the selection of visual mapping formats; the difficulties experienced in navigation by the pre-service teachers when using the visual mapping package, such as, screen size and printing problems; the problems of visualisation and the need for a package which could import visual or photographic images to enhance the deconstruction process; and the issue of cross-cultural applications when using the packages. In conclusion a number of significant findings have been addressed in this research project. Students unanimously agreed that the visual mapping package has enabled them to plan more efficiently, conceptualise their knowledge and ideas more clearly and allowed them to use the process successfully in two subject disciplines. As one student commented when using the package... 'her learning was active because it made her thinking process more visible and more structured'.

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The Problem of Transitions Between Discrete Multimedia Spaces

Jacqueline Bourdeau, Education, Université du Québec à Chicoutimi & Licef, Télé-université
jbourdea@uqac.uquebec.ca

In virtual learning environments, learners accomplish different actions in different media spaces, interacting with different tools and documents. However, they need to keep threads between their actions : logical, structural and functional threads. Based on what we know about actors, actions and situations in virtual learning environments (Bourdeau et al. 1998; Bourdeau et al., 1997), we recognize a problem in the transitions leaners make between different media spaces in three typical situations : individual, team and group. In an individual learning situation, actors interact with their tools and documents, with individual intentions, goals and objectives. The types of individual tasks can be: exploration, consultation, production, playing; the basic interface is a multimedia computer. In team-based situations (2-6 individuals), actors interact with each other and with tools and documents; they share intentions, goals, processes and tools. Their tasks can be: exploration, consultation, production, playing; tools can be shared applications and documents with video, audio or text conferencing. Group situations (6-30 or more) are different in many aspects: the media space consists of several sites equipped with videoconferencing rooms, with various types of computer-based facilities; actors may interact via a floor-taking protocol or via an animator; their tasks can vary from interactive presentation to discussion or collective decision-making.

In looking at actions rather than discourse, a central question is: how can learners keep track of their actions, processes and products? In various worlds that have different rules, how can learners find the threads they need in order to achieve their goals? What happens to the concept of seamlessness, considered as essential in human-computer interface design, when the media space is a room? How does the impact of tele-presence vary in the three different situations, from inter-individual text-based asynchronous communication to videoconferencing rooms for group interactions? If changing from one media space to another one presents obstacles to learning, or a loss of time and attention, should instructional designers recommend that, for each learning scenario, learners remain in the same virtual universe? Should designers search for new design principles in order to solve or to reduce this problem? How can pedagogical agents be designed to intelligently support the learning process, when learners going through these transitions?

Given three learning situations (I, T, G), a set of learning tasks, and a set of technologies, transition needs and problems can be identified, as well as potential solutions. As an example, it appears that Learner I1, when involved in the task of exploring, with a navigator, needs a transition process to Team T1 for referring, asking questions, displaying, reporting, or receiving feedback on his/her learning process or product. Transition problems can be the lack of transferring, of conversation, or of sharing facility. In another example, T1, when reporting to the group, wants to refer to interactions they have or had with T2, T1 may encounter transition problems such as lack of display or recording facilities; they can also face a problem of technological overload if they try to work with different media spaces at the same time.

Results from previous studies indicate transition problems when students move from one situation to another and change spaces at the same time. In the case of a Web-based business simulation, students shared information and tools for their teamwork within the simulation, but found themselves away from this space when meeting as a group. Coordination analysis pointed to critical interdependencies between actors and resources, where transition could be supported (Bourdeau & Wasson, 1998). In a videoconferencing-based group situation, students enjoyed a strong tele-presence through shared time and multimedia group space, but with no transition for individual or team situations once the videocommunication was cut off (Bourdeau et al., 1998). These problems can be anticipated and avoided in a design process that respected principles specific to these situations.

Coordination theory's framework, adapted to educational situations through analysis of interdependencies among actors and among resources (Wasson, 1999) provides a framework to identify potential coordination problems. Bates (Bourdeau & Bates, 1996) and Collins (1999) provide classifications for new media based on their attributes. These frameworks can be used in the design process in order to locate potential transition problems in the design. Among transition problems, some will soon find a solution through technological integration in network-based environments. In other cases, bridging processes (capturing, recording, scanning, reporting, projecting), or gateways can be built into the learning scenarios. Concepts such as seamless, transparent, and invisible, should guide the design for learning situations so that technology is not (too) intrusive.

In an attempt to find a solution to this problem, we suggest a design process in seven steps : 1) Analysis of the three situations, 2) Design of learning scenarios, 3) Modelling, 4) Virtual experimentation, 5) Field-testing, 6) Extraction of design principles, 7) Validation.

An analysis of the three basic situations (individual, team, group) is conducted while studying their components and their features : space (physical, virtual); channels (audio, video); time (synchronous, asynchronous, quasi-synchronous), duration and rhythm; interactivity; needs, potential and limits of each situation for transitions with the two others.

The design of learning scenarios involving the threefold situations (individual, team, group) gives specifications for the learning activities with their spatio-temporal dimensions.

Modelling is the activity by which the scenarios are dynamically represented with a modelling tool (Wasson & Bourdeau, 1998).

Virtual experimentation is conducted by manipulating variables in the scenarios and assessing the impact of the variations, using the modelling tool.

Field-testing represents a partial implementation of the scenario with a limited number of subjects and an observation protocol.

Extraction of design principles is oriented toward the design of: a) learning scenarios, b) technological environments, c) pedagogical agents.

Validation of these principles is done by a full implementation of a collection of scenarios with a data collecting protocol.

As a conclusion, a design problem has been identified and briefly described. A process in seven steps has been proposed in order to better understand the problem and its dimensions, and to propose directions for the design of learning scenarios, technological environments and pedagogical agents. The concepts of telepresence and of seamlesness receive special attention in this approach, as well as the consciousness of time and space by learners. This view underlines the necessity of analysis (using frameworks and modelling), and of observations (through virtual and real tryouts) when designing learning scenarios, in order to support the continuity needed in the learning process.

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Increasing Retention in Computer-Based Courses

Carol Berrey
Executive Director of Government and Public Affairs
Weber State University
United States
cberrey@weber.edu

The Special Problems of Computer-Based Teaching

Academia, both in the U.S. and abroad, is increasingly adopting new instructional delivery methods. Limited experience to-date shows that attrition rates for computer-based courses often runs higher than for traditional courses. Adopting savvy strategies can offset this handicap and significantly enhance student satisfaction and retention. The secret of retention in this new world is to help students feel and be involvedB-with faculty, with classmates, and with the institution.

This year I taught three consecutive terms of an online introductory interpersonal communications class. I found maintaining high levels of student participation and retention difficult but important, especially in the mediated instructional setting.

Because distant students= primary concern is losing interactivity with the faculty or other students, the most important adaptations make the learning experience more personal and less Amediated.≅

1. *Start with a good foundation*

   Require new student orientation. If students can=t log onto the World Wide Web, use e-mail or post assignments, they will be handicapped throughout the course. A grounding in Internet basics assures all students have the minimum skills for success.

2. *Develop integrated course curriculum.*

   Build in redundancy. Not everyone follows the same Alogical≅ paths to information. With hyperlinks the Internet provides a powerful tool for building a non-linear, multi-stream logical structure. For example, hyperlink the grading scale to the syllabus page, the assignment page, and the grade page to increase the odds of students locating key information.

   Include detailed course information. Online syllabi should provide all the information usually given in a traditional syllabus plus everything you would have said in classroom instructions. Instructor expectations should be especially clear to foster better communication and higher performance.

   Schedule multiple assignments. Rather than a single large paper/project/exam due at term end, design multiple small assignments or phases of a larger assignment due periodically during the term. This keeps student involvement constant, and allows you to identify immediately when a student is falling behind.

   Hyperlink appropriate Internet resources. Use the immediacy and breadth of information available on the net to enrich your traditional course materials.

   Do a complete dry run. After designing your online course, go through *everything, personally*. Log on as a new student, access the syllabus, post assignments, take exams and enter the chat room -- *try everything*. Then ask another person, with no familiarity with the course to do the same. This naive subject, like a cold reader, can often identify otherwise invisible problems.

3. *Create a friendly environment*

   Help students feel comfortable. During the first week introduce yourself, and invite students to introduce themselves. You might also post your photo, and invite students to do so.

   Send personal e-mail. Show the students that you are there and care about them. Send answers to questions, comments on individual assignments, or just contact students who have been suspiciously quiet. Even if you can=t respond immediately, always acknowledge a message or assignment received. Many systems automatically generate a return response. AGot your message -- full response follows.≅ This lets students know their messages aren=t lost in cyberspace.

Be accessible. Log-on frequently. More frequent log-ons, even if shorter, give a greater sense of faculty presence than do less frequent, but longer, log-ons. In addition to regular e-mail contacts, identify real-time office hours so students can telephone or meet you online.

Include electronic participation in grading criteria. Both personal experience and literature reviews suggest that the more frequently and actively students participate, the better their retention and learning. Encourage student involvement by making it a part of their grade, or by requiring a certain number and quality of interactions per week.

4. Treat students as active learners

Facilitate learning. Most online students are working adults, use to taking responsibility for themselves. Take advantage of this maturity by involving students as much as the first shot at answering each other=s questions before you jump in as the Aexpert.≅ Structure assignments requiring student collaboration, assign students to create exam questions, or have them evaluate each other=s work, etc.

Give substantial feedback. Students need full, concrete feedback on how they=re doing, especially with initial assignments. Explicit examples of what they=ve done right and/or wrong are more helpful than general comments like AGood job!≅

>Unbundling= Instructional Tasks

Academia already Aunbundles≅some traditional instructional activities, shifting them from overworked and costly faculty to skilled helpers. Teaching assistants grade, academic advisors counsel, and departmental secretaries post grades. Online teaching is even more suited to unbundling.

Technological complexities and system glitches are constants in mediated teaching, and demand a Ahand holding≅ function. Students don=t see faculty in class, so they must find answers already posted, or contact someone to get the information. Even if you post and students are able to find a detailed syllabus, questions inherent in the technological medium will still arise. AIs that hyperlink dead?≅ AHow long will the system be down?≅ AWhy doesn=t my password work anymore?≅ require a personalized answer.

A few weeks into the quarter, I realized I had *de facto* unbundled the course. I continued the traditional instruction tasks, but my secretary became the class manager. Available by phone, fax or mail during regular business hours, she handled day-to-day class operations, answered procedural questions, walked students through processes, checked on system glitches, and posted grades online. She also monitored student log-on frequencies. If a student went inactive for a specified period, she alerted me so I could make special contact to identify problems and encourage reactivation.

Conclusion

The demand for higher education continues to grow exponentially throughout the world. Already, mega-universities in China and India enroll as many as 250,000 students, many taught via distance education. The rapidly changing face of education brings new opportunities but also the demand for innovative solutions. Teaching online presents additional challenges, but a creative, problem-solving attitude and artful strategies make it rewarding for both faculty and students.

DUKES: Creating Real-Time Variable-Speed Speech for use in Educational Multimedia

Kevin A. Harrigan
University of Waterloo and TeleLearning Network of Centres of Excellence
Department of Computer Science
University of Waterloo, Waterloo, Ontario, Canada, N2L 3G1
Email: kevinh@uwaterloo.ca

Introduction

DUKES is a computer application that we have created to allow developers of educational multimedia to produce applications that include real-time variable-speed speech. Variable-speed speech is speech that is played back in more time (called time-expanded) or less time (called time-compressed) than it was originally recorded. For example, a one minute speech segment played back in 40 seconds is time-compressed by 33%. Research has shown that learners can listen to speech that has been time-compressed by up to 50% without any loss of comprehension or retention (Harrigan 1995; Harrigan & McLean 1995). People normally speak in the range of 125-175 words per minute (wpm) and silently read at 275-300 wpm. Thus, when listening to time-compressed speech which has been compressed by up to 50% learner's are listening at approximately the same rate at which they would silently read. Listening to time-compressed speech can produce a significant increase in learning efficiency (learning per unit of time) compared to listening at normal speed, without any known negative side effects.

Producing Variable-Speed Speech

There are various methods of producing variable-speed speech. Learners do not like the "Mickey Mouse" effect that is produced when speech is time-compressed by simply playing it fasterr, so researchers have create various other methods of time-compressing speech without a significant pitch change. Some of the most often cited methods are: (a) removing pauses in the speech, (b) removing small chunks of the speech at regular intervals in time, and (c) using the Synchronized Overlap and Add (SOLA) (Roucos & Wilgus 1985) technique. In the implementation of DUKES we have used the SOLA technique because it produces the best quality speech of all the methods (Arons 1994).

The SOLA method is a selective sampling method. With this method, the beginning of a speech segment is overlapped and averaged with the previous speech segment at the position of highest cross-correlation. The resulting time-compressed file is of very good quality, and there is no significant change in pitch. The SOLA method requires a large number of multiplications and additions in the calculation of the point of highest cross-correlation but our implementation has been optimized to run in real-time on a Pentium 90MHz or faster computer.

Before we developed DUKES, we used Wave for Windows (Turtle Beach Systems 1992) to create educational multimedia applications in which we included multiple versions of the same speech file which was time-compressed by various amounts such as 15%, 30%, and 45%. We then gave the learner the ability to change speech files at any time. This worked quite well (Harrigan 1995) but it was limited in two ways: (a) multiple speech files consume an enormous amount of disk space and (b) the learner could only select the time-compression percentages that we provided rather then being able to select their own. We developed DUKES so that we could give the learners more control by allowing them to control the speed of playback in real-time. To date we have only concentrated on speeded-up speech but our application has the ability to slow down speech as well.

The DUKES Software

Figure 1 shows screen images of the only two screens in DUKES (note that DUKES could be imbedded within an application and thus the learner may not see this interface). It shows that the input can be from a sound file or in real-time via a sound card. Our application determines the characteristics of the input signal. The user is given control over the default parameters that control the quality of the resulting signal. The resulting speech can be saved as a sound file or played on the sound card, whichever is appropriate. When the user selects "Do TSM" to do the conversion (known technically as Time Scale Modification) a second screen appears to give the user the ability to change the speed of the speech as the speech is playing.

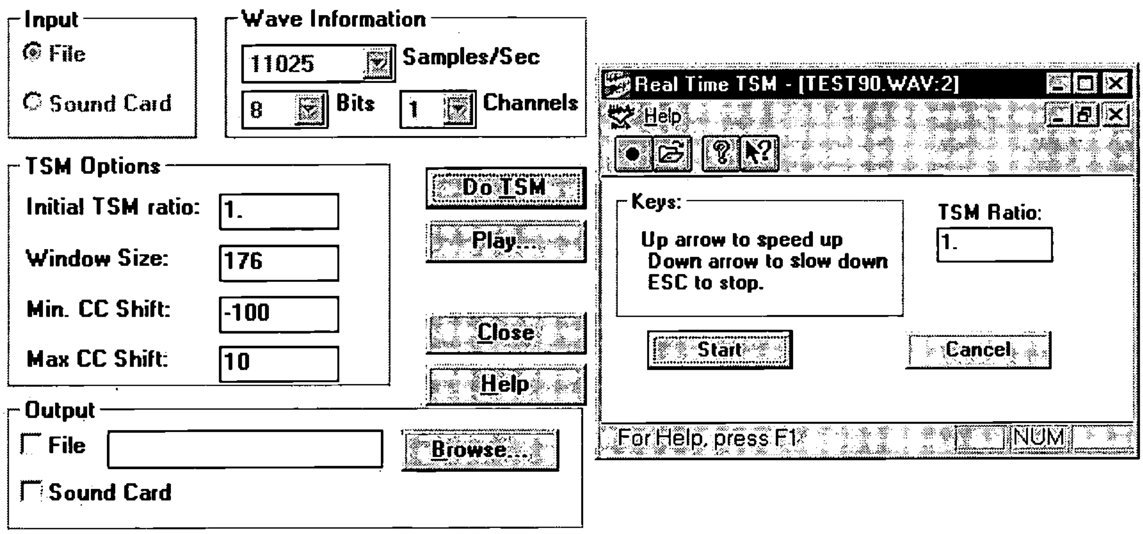

Figure 1. Screen shots of the only two screens in the DUKES software for creating variable-speed speech.

Conclusion

We have used time-compressed speech in several educational multimedia applications and have received no negative feedback from our learners. We feel that variable-speed speech is a feature that designers of educational multimedia applications should consider using in the products that they produce. Our software is available as freeware from the author.

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On the Receiving End – Supporting Faculty and Students in a Distance Learning Environment

Gail S.M. Evans, J.D.
Executive Director and Dean, The University Center
North Harris Montgomery Community College District, U.S.A.
and Professor of Business Law, The University of Houston-Downtown, U.S.A.
gail.evans@nhmccd.edu

Key to the growth and success of distance education as an alternative delivery system for university courses is faculty confidence in the effectiveness of distance education systems for the delivery of curriculum, and student satisfaction with the learning experience in a distance education environment. Yet, too often, the planning process is managed by persons who have little or no experience in teaching in a distance environment. And the technology issues are often so daunting that they become the dominant concerns of all involved. Lost in the discussion are the needs of the faculty and the students. These needs have special relevance for the persons serving as the link between the students and faculty – the on-site administrators of remote site facilities.

The University Center of North Harris Montgomery Community College District (NHMCCD) is a collaborative partnership of the community college district with six publicly funded universities: Prairie View A&M University, Sam Houston State University, Texas A&M University, Texas Southern University, University of Houston and University of Houston-Downtown. NHMCCD covers the northern one-third of the Houston metropolitan area. Residing within the district's boundaries, which cover more than 1400 square miles, are 1.2 million people. No university is located within the district's boundaries. NHMCCD took the lead in developing The University Center (TUC) to improve access to higher education for its graduates, residents, and businesses. The six university partners deliver all required upper division and graduate courses to support 30 undergraduate and 23 masters level programs. In some instances, entire major programs are being delivered using compressed video interactive classes originating at the main campus location. Some programs are delivered using a combination of live-on site, compressed video, tape, and Internet.

Approximately 170 sections of upper level and graduate courses are offered each long semester at The University Center. Of these, approximately 40% utilize compressed video interactive technology for delivery to multiple sites. Four of the six partners utilize the compressed video technology. In most cases, TUC is the "receive" site. However each semester anywhere from 4 to 8 sections will originate on a regular basis from TUC. And in approximately half the remaining sections, the faculty member will travel to TUC at least once during the semester to broadcast the course from there. Thus, the primary focus of concern for The University Center is providing adequate support to facilitate delivery of compressed video interactive classes.

Because The University Center draws from several universities with different policies and processes, it provides an excellent laboratory for gathering information and testing support strategies to achieve a high level of student and faculty satisfaction with distance education. This paper presents the results of two surveys. The first was directed to faculty to identify their expectations related to types of support that they perceive necessary for their distance education courses to be successful. The second was directed at students to determine their level of satisfaction with the compressed video classes at The University Center. The surveys are part of an annual assessment process used to review current practices at The University Center and to initiate change as appropriate.

A brief summary of current classroom operation provides the framework for understanding the information gleaned from the surveys. In the typical "receive" classroom situation, a member of the student services office meets the class the first day prior to the beginning of class. She provides a brief explanation of using the push-to-talk microphones and describes to the students the process for calling for technical assistance using the telephone in the classroom to page a technician. She hands out the syllabus for the class and any other material the faculty member has sent. Additionally, she demonstrates to students the procedures for redialing a class in the event of disruption.

For daily class, a technician connects the class approximately 15 minutes prior to the start time and tests the audio as well as video transmission. Students arrive and take their seats just as for a live-onsite class. A student services staff person brings any handouts to the classroom and collects any papers which she has been notified by the faculty member to collect. Students are unattended during the class period. Exams are proctored by a contract proctor, if requested by the faculty member. When only a couple of students are at the "receive" site, the faculty member will often proctor using the connection. In those cases, a student services staff member distributes the exams at the beginning of the class period and then returns at the end of the period to collect the exams. Students who leave early place their exams on the desk if they do not want to remain until the staff person returns. If the course requires a class presentation, then the student services support staff provides broadcast training for the students, demonstrating to them the process of changing from camera to powerpoint to document camera. Students are allowed access to the classroom for practice. At this time, only one college from a partner university utilizes web-based classroom management software to support delivery of its courses.

Overall, the types of support that faculty perceived to be important for their compressed video courses to be successful were directly reflected in the students' level of satisfaction with the course. The two areas of greatest convergence centered on technology and getting information/assignments/tests to and from students. Faculty expected the technology to operate in a trouble-free manner, and for technical assistance to be quickly available. Students correspondingly, found interruptions in the broadcast, and inferior quality in such things as audio, to affect how they felt about the course. Where there were continual technical problems, students were less satisfied and expressed concern about taking another course delivered via compressed video. In response to this finding, The University Center technical staff instituted a room log to track connection problems. This procedure will help to quickly distinguish general problems from those that are specific to connecting with a particular institution. Additionally, to speed troubleshooting, the staff developed a "call a tech" procedure using the alphanumeric paging system through the computer to page the technical person on duty. By following the instructions taped to the desk by the computer keyboard (just in time instructions) the student can send a page with the room number and brief description of the problem. That information can help the technical staff determine quickly the magnitude of the problem and level of response necessary.

Faculty want and need to get information/assignments/tests to and from students in a timely manner to derive maximum pedagogical value from the activity. And students indicated on their surveys a high level of frustration at the amount of time it often took to receive back graded work. The highest level of dissatisfaction existed where the universities were using an informal courier system (i.e. whoever happened to be headed to the vicinity of TUC) to transport materials. In that case, faculty felt they were not being supported because it would sometimes take more than a week for materials to reach the students. And the students were dissatisfied because they didn't know how they were doing in the course or felt they were at a disadvantage when compared to the students who were physically with the professor at each class. In those cases where overnight express mail service was used to send materials both parties were somewhat more satisfied. The problem was significantly diminished in the case of the partner university using course management software to communicate the syllabus and transmit assignments. In response to this finding, whenever possible TUC now utilizes express mail to send to the faculty member all class materials collected. Additionally, the TUC staff is evaluating the feasibility of providing access to course management software through the TUC server for those faculty who do not have such access at their universities. The information gathered in this section of the survey demonstrates the value of systematic assessment in identifying needs and devising solutions. By pinpointing the relationship between high satisfaction and the efficient transporting of materials between students and faculty, TUC was able to justify the budget expenditures related to using express mail and to provide incentive to its partners to seriously consider mechanisms for web support for classes.

The U.S. Department of Education has reported that more than 50 percent of American colleges and universities offer or expect to launch distance-education programs in the near future. If distance education is to prove a successful system for bringing education to the people then we must move from our preoccupation with technology and address the nuts and bolts issues of support. The information derived from systematic surveying of the parties most affected by the technology - the faculty and the students - provides a basis for beginning to address this issue.

Early Experiences in Broadening the Use of Web-Based Learning to Mainstream Faculty

Wendy Freeman, Digital Media Projects Office, Ryerson Polytechnic University
Dr. William Brimley, Digital Media Projects Office, Ryerson Polytechnic University
Dr. Rheta Rosen, Learning and Teaching Office, Ryerson Polytechnic University.

The history of instructional technology is littered with discarded technological innovations that promised to revolutionize the way teaching and learning occurred. This paper will describe the efforts of the staff of the Digital Media Projects Office at Ryerson Polytechnic University in introducing an integrated web-based course delivery package called WebCT to Ryerson faculty and students. The goal was to provide and support a software package that would enable faculty considered to be non-technical to use the web for instruction, extending the reach of this instructional technology beyond that of the typical innovators and early adopters. In this paper we will report on our efforts to ensure that these web-based tools do not ultimately contribute to the list of discarded instructional technologies. Specifically we will reflect on the techniques used to promote and support WebCT, our experiences on the successes to-date and suggestions on how to continue to reach out to faculty not already using web-based tools for instruction

Ryerson Polytechnic University is an undergraduate university in the heart of downtown Toronto. Full-time and part-time student programs are divided into five faculties covering 37 program areas. Faculties include Applied Arts, Arts, Business, Community Services, and Engineering and Applied Science. In addition to 14,000 day students, there are 65,000 student enrollments in continuing education courses (both on campus and through distance education).

In 1996 the Digital Media Projects Office (DMP) was established to provide support for faculty with an interest in using multimedia for instruction. The DMP provides a range of services for faculty including, workshops, drop-in multimedia suites, and consultation. Faculty receive support in presentation technologies such as PowerPoint, web authoring, and advanced multimedia authoring (Brimley, 1998).

The orientation of the DMP is to provide support for faculty with the goal of helping them to develop the skills to create their own multimedia resources. This approach has been very successful for a small number of faculty that could be classified as innovators and early adopters according to criteria suggested by Moore (Moore, 1991). The DMP workshops are typically attended by faculty willing to learn to use technology that is rapidly changing, that may be in a beta or development phase, or that requires a significant time commitment.

In the summer and fall of 1998 the DMP introduced WebCT, an integrated web-based course delivery software package. WebCT is just one of many new like products becoming available to higher education institutions in the past few years. These integrated packages combine common internet-based tools such as threaded discussion groups, real-time chat, web page delivery, online quizzing and student management in one package. The instructor can mount and maintain a fully functioning web-based course with little or no technical knowledge of the intricacies of web servers, Javascript, or Perl, etc.

The software was introduced to provide an accessible set of tools for web-based instruction. The goal in introducing WebCT was to continue the efforts of the DMP to assist faculty in becoming self-sufficient when using technology. An effort was made to make web-based tools accessible to a group of faculty as yet reluctant to use the web for teaching. This group of faculty is classified as the early and late majority or the mainstream by Moore (Moore, 1991).

In his paper "What Ever Happened to Instructional Technology", Geoghagen (Geoghagen, 1994) suggests that mainstream facultydiffer from their innovator/early adopters colleagues in their reasons for adopting any new technology. Primary among these reasons is a general interest in the technology itself. While innovators and early adopters are "techies" willing to explore the potential of the technology, the mainstream is not. Faculty falling into the mainstream are interested in seeing tried and tested applications and do not want to use technology that is not congruent with the way they carry out their daily tasks.

As well, different methods are required to promote and support new technology for the different groups of adopters. The standard strategies of highlighting the technology itself and teaching people how to use the technology may be appropriate for faculty interested in technology, but this is not effective for mainstream faculty. The mainstream is more inclined to show interest in a new technology if it is easy to use and does not require a major change in the skills they already possess.

With these issues in mind, the DMP set out to select and implement a web-based course delivery package for mainstream faculty. Our primary assumptions in selecting WebCT were that the software should meet the instructional needs of faculty using the web for instruction and that little or no knowledge of HTML should be required.

As much as possible, faculty were involved in the selection and implementation process. A committee of faculty and support representatives was formed to assist in the final selection of the software package and to advise on the implementation plan. A short survey was circulated to provide the committee with feedback on the key features required by faculty.

All faculty were invited to participate in the pilot project. One training session was arranged and two more were added after the overwhelming initial response. During July and August 1998, 54 faculty were trained in how to use the basic features of WebCT and how to convert standard word processing files to HTML.

An effort was made to provide as much a support as possible. A student was hired to provide telephone and one-on-one support. In addition, a listserv, an e-mail address and a website were provided (http://www.ryerson.ca/dmp/courseware) to communicate with faculty participating in the pilot. At the start of the school year one more support person was added to assist faculty and when necessary, students in using WebCT.

In the first semester there were 25 faculty using WebCT to offer a total of 34 courses with approximately 3,500 students enrolled. WebCT is being used across the five faculties and for all four years of study. In its second semester WebCT was used to offer 44 courses by 32 faculty.

It would appear that WebCT has attracted some faculty that had not yet used web-based instructional technology. A small group of faculty who are interested in or are now using WebCT know nothing about HTML and had not used the World Wide Web for instruction prior to WebCT.

In an effort to assess the effects and effectiveness of the WebCT pilot, student and faculty surveys are being used to gather data. Faculty were asked about their previous experiences with this type of instructional technology, their reasons for choosing to use WebCT, how they are using WebCT, etc. Students were asked similar questions about their experience with the Internet and the computer along with the barriers and uses for WebCT.

It is perhaps too soon to reflect on the reasons for mainstream faculty adoption of the web as an instructional technology. However, it may be possible to make some general observations about the effectiveness of our decisions and process so far.

The decision to involve faculty in the selection and implementation process was a good one. Input provided DMP staff with insights into the day-to-day needs of faculty that would not have been considered otherwise. WebCT has proven to be a tool that is attractive to mainstream faculty because it is flexible, it meets some or most of their instructional needs, and because it is an aid in course administration.

Although support personnel were not always kept busy, faculty appreciated knowing that there was a high level of support should they need it. As faculty take small steps toward full course implementation and begin to push beyond their current WebCT skills the number of support calls has increased.

There are factors beyond our planning and procedures that contributed to the pilot's success. These factors include increased access for both faculty and students to networked computers, a growing understanding of the instructional applications for the Internet, and the availability of WebCT and integrated packages like it that are designed specifically for web-based instruction in higher education.

As we begin to plan to move out of the pilot stage we are refining our strategies and continuing to look for ways to make the web more accessible to mainstream faculty for instruction. We have initiated a "house call" service that provides one-on-one consulting for faculty using WebCT. Initial faculty and student feedback suggests that we must put more effort into supporting students to eliminate the support burden for the faculty. We will also continue to investigate better tools for creating web pages from word processing files. Finally, by focussing on the instructional applications of this technology we continue to explore the World Wide Web as a means for effective and innovative teaching.

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The Venezuelan Universities and the Cyberspace

Rosa María
University of Zulia, Maracaibo
Venezuela

Increasingly, both the public and private sectors are demanding more efficiency from public Venezuelan universities. This pressure for efficiency in education has resulted in an increasing adoption of New Information Technologies in the educational, research and administrative areas of higher education. In fact, the use of NIT in Venezuelan universities is superior to averages elsewhere in the Latin America and in the world.

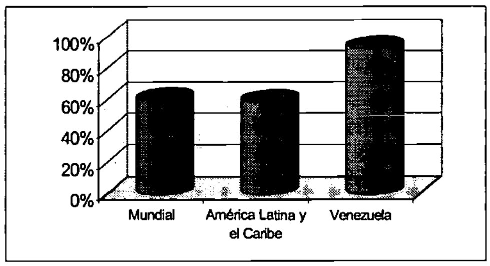

Figure 1: Universityes Web Sites

The above chart shows that while 60% of the universities in the world have a web site and 58,8% of the South American and the Caribbean universities have a presence on the web, almost all public Venezuelan universities (89%) and less than half of the private ones, have a web page that basically fulfills the institution's information needs.

However, in analyzing the possible uses of these technologies, it is clear that only a few universities have effectively incorporated the NIT into their systems.

For example, while some universities such as the Universidad Simon Bolivar, the Universidad Central de Venezuela and the Universidad Nacional Experimental Simón Rodríguez use NIT in the decision making process, only 40% of the public universities with on-line systems use them as a support for the research activities.

Mostly, the NIT are being used to display information on the web about the universities' programs and mission. However, without a clear picture of the total information system and its relationship to a communication policy statement, it remains unclear how NIT are being incorporated to the universities policies as a whole.

Despite the efforts made, only three universities (Universidad de los Andes, Universidad de Carabobo and Universidad Simón Bolivar) have an effective on-line library consultation service. The others struggle against the generalized financial crisis and poorly trained personnel to update their library collections.

E-mail services are not of common use: i.e. only 25% of the professors at the Universidad del Zulia (the second largest Venezuelan university) has and uses an e-mail address. It was during the second semester of 1998 when administrators of this university began using e-mail services to communicate with the faculty.

The use of NIT among each university has grown at a different rate and speed, thus displaying different modalities. This hinders both inter-operability between systems, as well as each system's uses. For example, private university students produce 100% of the "unofficial web sites"; students attending public institutions have made none.

Universities like Universidad del Zulia, Universidad de Carabobo and Universidad de Los Andes develop communication infrastructures that include not only web sites and e-mail and Internet services, but also Radio and Television Stations of public service. However, these services do not collaborate to foster and coordinate a common communication objective.

The architecture to build the different systems among Venezuelan universities varies. The Universidad Nacional Experimental del Táchira's project is based on a joint venture with IBM. The system will serve the administrative and academic sectors and coordinate the beginning and development of specific data pools of academic information (Regional Information Center, Research Lab, Libraries, Dean's Office and all units that require information services).

The UNELLEZ (Universidad de los Llanos Ezequiel Zamora) established an agreement with the Universidad de Carabobo for the development of specialized services of personalized consultation on the library. This will allow access to the university's databases as well as to on-line consultation by modem at all four of its campuses.

The Universidad de Carabobo could be considered the biggest virtual library of the central area of Venezuela. This institution is performs highly in the area of information management.

In 1987, the Universidad Simon Bolivar began an internal discussion on the differences between *information industry* and *knowledge industry* concepts. The discussion resulted in a small team of information and technology specialists who input data for the Information system of the institution. The system bases its performance on the matrix organization, an organizational structure that characterizes the Universidad Simon Bolivar. This team of specialists also manages the web sites of the university.

The Universidad Simon Rodriguez pursues a project considered the most advanced in Venezuela. It consists of the use of networked computers to enforce the curricula development model of the university, a model based on the Andragogy. The project also includes intercommunication with 27 satellite campuses of the university around the country.

While most of the Venezuelan universities claim that they use NIT, just a few have their entire library collections available for on-line consultation. Some others offer workstations with basic programs, such as word processors for at least half of their student body, but very few can guarantee workstations with internet access, e-mail service and on-line data search capabilities for research purposes.

Despite the evident delay in the full application of NIT, Venezuelan universities have made a great effort to update their technological infrastructure and to adjust their management methods to become more efficient through the uses of technology. Even so, the major challenge they face is to overcome the financial crisis that characterizes most underdeveloped countries. Such a barrier must be surmounted if Venezuelan universities are to offer the top quality education level opportunities necessary for students to gain a seat at the banquet with those who are educated in the wealthier, technology-rich countries of the world.

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Remote Control of Hybrid Analog/Digital Video Networks in Distance Learning Environments

Anatoliy Gordonov: GORDONOV@POSTBOX.CSI.CUNY.EDU

Roberta Klibaner: KLIBANER@POSTBOX.CSI.CUNY.EDU

Computer Science Department, Staten Island College, City University of New York,
2800 Victory Blvd. 1N-215, SI, NY 10314, USA

Introduction

Hybrid Analog/Digital Video Networks (ADViNet) become more and more popular on the market. They are employed in the applications that require full-screen motion video transmission in the local area networks and, at the same time, cannot afford slowing down regular network activities. Among these applications are real-time control systems, electronic classrooms, and distance learning environments.

The typical physical architecture of ADViNet includes two communication media: digital and analog (Computer Video Web 1996). The digital medium is used by a regular digital network according to its type and topology. The analog medium combines a VGA bus with several additional control lines.

ADViNet allows users to send real-time full-screen motion images through an analog communication medium. Main video network operations--Broadcast, Multicast, and Monitoring-- cover basic instructors' activities such as lectures, tutorials, individual and group supervision. Recently developed logical level intelligent video network operations make teaching in the ADViNet environment more productive for the students and instructor (Gordonov A. 1997), (Gordonov, A., Kress, M. 1997). However, the architecture of ADViNet permits its use only within a limited area. A distance learning environment includes groups of network nodes dispersed far apart. ADViNet, being very useful in a local classroom, cannot automatically be used if several local classrooms participate in the same session. In this paper we present our current development of a distance learning environment that includes several classrooms equipped with ADViNet. We define distributed video network architecture, methods of video transmission between sites, and methods of the remote control of a remote site.

The Architecture of a Distributed Video Network

First of all, let us give several definitions:

Cluster - a set of computers connected to the same ADViNet video bus.

Primary Cluster - the main cluster in the distributed distance learning environment where the instructor is located.

Secondary Cluster - any remote cluster which participates in the distance learning session.

Primary Teacher station - the teacher station in the primary cluster.

Secondary Teacher station - the teacher station in a secondary cluster.

A general structure of the distributed ADViNet architecture is shown in Figure 1. Video information may be transmitted between nodes inside a cluster and between the clusters. Each node of a cluster can use ADViNet to transmit images from one member of a cluster to some others. Technically, digitized video

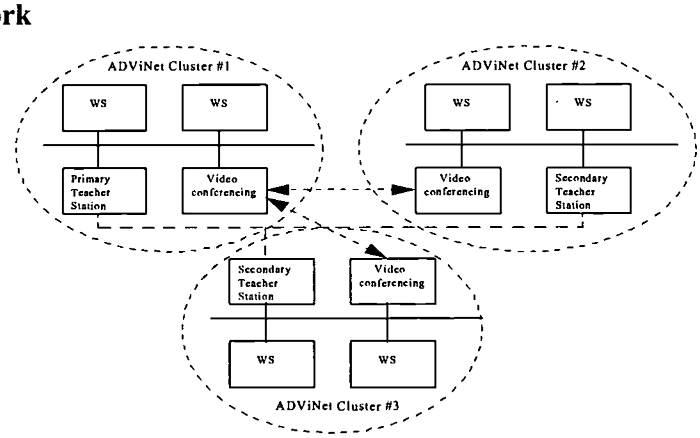

Figure 1: General Structure of Distributed ADViNet.

can be transmitted from one cluster to another. Virtually, any commercially available videoconferencing system (such as CU-SeeMe, Intel ProShare, Tenberg, etc.) may be used for this purpose. Some of them (such as CU-SeeMe, Intel ProShare) must be installed on the teacher stations in each cluster. In this case video information is distributed inside the Primary Cluster through the local ADViNet and may be transmitted to the Secondary Teacher stations over the videoconferencing system. In the Secondary Clusters local ADViNet sends video information to all the local nodes participating in a session. If the videoconferencing system is a separate device, it should be connected to a teacher station though a video card. It allows this station to provide exchange of video information through the videoconferencing hardware. The quality of video transmission depends on the characteristics of the digital channel between clusters and is very often limited by these characteristics, yet, it could be acceptable for many applications. Inside each cluster, ADViNet relieves the burden of video distribution. Using ADViNet in any cluster insures delivery of video information to any student station without interfering with other network users connected to the same local area segment. Although technically possible, this structure suffers the lack of remote control: a user in one cluster cannot control video equipment in others. In a distance learning environment the remote control is a vital necessity. It allows the instructor to implement many functions (such as remote control of video equipment, control of video distribution in a remote cluster or remote ADViNet configuration) without asking for assistance at the remote site.

For control and management purposes, in any cluster one station (control station) is chosen for remote communication with other clusters. By default, this is a Teacher station. For any session, one of the control stations is the primary control station, and the others are the secondary control stations. The primary station communicates with all secondary ones. Any secondary station may gain control over the entire video network (which includes several ADViNet clusters) only after it gets the permission from the primary control station. The primary station may set and monitor a time limit for the current session, may extend this time, or interrupt the current session. Any control station which is authorized to manage a video session may request from all other control stations the information about the current status of the ADViNet clusters and/or send the necessary commands to change the local mode in an ADViNet cluster. It may also issue special commands to control video equipment in a remote site such as video cameras or teleconferencing equipment. During a session, a cluster may drop the connection or connect to the current session. By default, the Primary Teacher station controls the distributed ADViNet. Any Secondary Teacher station may gain control over the distributed environment after getting permission from the Primary station.

All remote control commands as well as local ADViNet commands are included in the Remote ADViNet Management Protocol. This protocol allows the users to control video distribution in remote clusters in the same way as they do it in a local area network. Most local operations are implemented remotely. Among them are various types of broadcast, multicast and management operations.

The distributed ADViNet architecture and Remote ADViNet Management Protocol are supported by specially developed software. This software provides remote programming control in a number of ways. Recently we have developed three different variants of establishing communication between Primary and Secondary stations. They are:

- communication through a local area network. This situation may happen when all the clusters are located inside one campus. The supporting software works in the Windows NT environment and may use any available protocols for the communication;
- communication through TCP/IP protocol. The communication may be established between any nodes connected to the Internet or inside a local area network with appropriate protocols installed;
- transmission of the control information using special functions of the videoconferencing systems. This method is used if not all the clusters have the Internet connection. Intel ProShare videoconferencing system includes a special function that supports transmission of text or binary information concurrently with video. This function is used to establish communication between clusters and to transmit commands.

The proposed paper represents an ongoing project. The implementation of the proposed distributed video network architecture and methods of the control of a remote cluster allow us to incorporate ADViNet in the distance leaning environment and use all the benefits of ADViNet in any cluster.

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"HISTOMANIA" A VIRTUAL ENVIRONMENT PROMOTING A COMMUNITY FOR HISTORY STUDY

Avigail Oren
Zvia Lotan
The Center for Educational Technology

While browsing the Internet we may find various types of educational sites, but not all of them could be addressed as an environment hosting a learning community. In this article we would deal with both terms in order to show their educational advantages, Likewise, describe Histomania as an environment hosting a virtual community of people interested in history.

Virtual communities and environments

A survey, that explore learning communities, defines two types of communities existing side by side, even in our time. One type refers to people basically sharing a common place and the other type is based on people sharing interests. Both types include members sharing culture (language and values) and communication means (Office of Learning Technologies, Canada, 1998). By that definition learners and teachers in school form a community of the first type and subscribers to theater or music programs form communities of the second type. Members of the first type do not choose their membership (the place and the subjects studied), but they share a place, use common culture and feel affiliated to the school. Members of the second type are volunteers who choose to be part of the community on a ground of common interests. But, in order to fulfill their membership they also have to share a specific place and time. The main feature of network technology is the communication capabilities which may free the community from being place and/or time bounded. The main question is how do we use these net capabilities as a place for developing a community which will promote the study of history.

When analyzing the term "virtual community" we find two phases in the community development: registration and ongoing existence. At the registration phase people check in voluntarily and look around to find out whether they may gain advantages or be satisfied socially. At the ongoing phase membership is significant if the member feels that he contributes to the community and that he is gaining advantages from his visits. Likewise, he has to develop a sense of identity and a feeling of affiliation. These will emerge only if social bonds will be established between members. We assumed that given a place where teachers may consult each other and hold a dialog with historians and history instruction experts will create conditions for a community. Likewise, offering students tips for learning history and game like activities might do the same. Moreover, the opportunity of a dialog between students and teachers, teachers and parents, students and parents, who will know each other only virtually, will help in crating a new trust between populations who seem to be in an ongoing conflict.

Virtual communities grow and function in virtual environments. The environment that hosts the community represents the logical framework as well as the virtual place for its existence. It is apparent that the communication layer of a web site is a main factor in establishing a virtual learning community by supplying the social factor needed in the learning process. Likewise, we propose the idea that conditions needed for a community to emerge and evolve are not only the technological capabilities of the net but also a meta outlook which produces not a site but an holistic wired environment. we define an "holistic learning environment" as a set of web sites who share the same meta subject (for instance, a discipline) and supply a place for various interested visitors (like, students, teachers, parents, specialists) etc., by means of CMC. We argue that the existence of a larger structure to which the discrete sites belong gives rise to a feeling of stability which creates an atmosphere of security and seriousness. We assume that this atmosphere helps the visitors in developing a sense of identity with the environment, similarity with other users and willingness to visit once more and participate in the activities proposed there.

Histomania

The environment is a tryout to implement the concepts described above.
It is based on a holistic approach in web based learning where the environment should be a combination of information handling and of communication tools. Developing a community is the main aim of the environment. Like in virtual places the membership is on a volunteer base. Any body might be a guest. In this position he may

look over the information sites available at the resources center. But it is expected that guests will find the place interesting enough to register as members.
The environment consists of five components:

Following Time
A resources center comprised of several sites, most of them build as data base including a search engine, and all are related to the to the Israeli history curriculum. We think that the focus of history instruction should be the primary sources - texts and visuals.. Therefore, primary sources as well as historical research are the main content of the resource center. The place is divided into four parts according to historical periods: The Classic World, The Middle Ages, Modern Western Society, Contemporary History. In each period Jewish History is dealt as well. The center is intended for students who wish to prepare papers or presentations as school projects and for teachers who look for primary resources for building their lessons.

A Disciplinarium
A center which serves history teachers according to needs defined by the members. Discussion groups enable teachers to discuss pedagogical questions related to the implementation of learning materials. Participants are requested to contribute ideas, tips, questions etc. to each other. Likewise, teachers are expected to send to the students' center tips for learning history or participate in students discussion groups. Members may also meet in a chat room where they may talk on any subject they like and develop social relations. Parents may participate in discussions groups of teachers, but have also a place of their own where they may discuss other subjects as they will define.

Tips from Clio
The students center. That is the place where students may share information with other students, discuss subjects in moderated groups, get tips for history learning from teachers, students, and from any body else who will be willing to help. At the same section where learning occurs a chat room called "Nirvana Pub" operates. That is the space where students may talk freely and develop social relations. Being members of the community, students may ask historians questions in subjects that they are interested in.

Time Machine
It is an effort to use edutainment concept for enhancing motivation towards historical issues.
Riddles, puzzles and crossword puzzles are organized in a curricular approach and are related to the Israeli Syllabus.

The "Seal Defenders" Club
The club will include members who proved themselves to be as active. They will be coaches of new members, guides to guests, participate in mingled discussion groups (students, teachers, parents, and historians) and talk over issues in history and in education as well. Club members will propose new ideas to be developed in the environment and evaluate ideas proposed by non-members.

In the recent months almost 700 teachers registered voluntarily and 400 students. 3 projects based on the resources embedded in the environment were held. Students from different schools used primary resources and participated in discussion groups. Some students send riddles and puzzles they solved. Teachers participated in discussions held in the the disciplinarium and some of them sent lesson plans and recommendations related to history sites on the the Internet.
Still, we are not satisfied with the activity done but feel that we are in the right direction.

Masters' Portfolio in Project Management Through Distance Education

Cecilia Hannigan
Lecturer

Mike Browne
Director

Centre for International Project Management
University of Ulster at Jordanstown
Northern Ireland
Email: cm.hannigan@ulst.ac.uk, ma.browne@ulst.ac.uk

1 Overview

The University of Ulster has approved the planning of a linked series of postgraduate awards by distance education that will focus upon various themes within the Project Management discipline. The international market for project management is extensive in both the developed and developing world. We have identified students in Asia who wish to undertake postgraduate courses at an overseas University but who cannot, for various reasons, leave their job or family to study abroad.

The Centre for International Project Management, based within the Faculty of Engineering has been established to deliver the Portfolio. It will draw upon the expertise of staff from the School of the Built Environment, the School of Electrical and Mechanical Engineering, the Faculty of Informatics and the Faculty of Business and Management. Critical factors involved in the success of this venture will be:

1. The formation of joint ventures and strategic alliances with other institutions and colleges based in each country where the courses are to be delivered and
2. World-wide commercial and professional organisations that can introduce state of the art practices into the curriculum.

Modern organisations are effectively introducing change through the use of business projects that will further their corporate objectives. We will meet the requirements of prospective part-time students, in their late twenties to early fifties, who have been chosen by their organisations to deliver such projects. Initially, it is anticipated that two streams or pathways will be available. These pathways are Construction and Engineering and will be followed by Informatics, Business and Leisure and Tourism, dependent upon demand.

University of Ulster (UU) academic staff will deliver the Portfolio via a series of residential courses at each international centre, supported by the staff of the local institution, independent study materials and dedicated UU administrative staff. The role of the International Partner Institutions is extremely important to the successful delivery of the Portfolio. We expect each institution to send a member of their staff on our existing Masters Programme to get a level of expertise in the discipline and form links with our staff, with a view to their being involved in the local co-ordination of the Portfolio on their return home. The use of advanced telecommunications facilities would be incorporated into the delivery and support aspects of the Portfolio. Teaching approaches will comprise a combination of conventional methods and tutoring via the Internet, using an integrated environment specifically for this purpose. In addition, supplementary resource material, in the form of CD ROMS, videos and paper-based materials will be distributed to the students.

As an open and distance learning programme, the duration may be varied dependent upon the requirements of each country. However the preferred model of delivery is that the taught modules will be completed over sixteen months and the Dissertation and accompanying Project should be completed in a further eight months.

2 Rationale

The rationale for developing the Portfolio is to

- Meet the increasing global demand for qualified project managers
- Develop further our existing Masters' programmes
- Provide a focused strategy for growth in teaching and research
- Enrich staff development via the direct experience of design and implementation of distance education programmes
- Further the achievement of the University's international objectives
- Indicate the University of Ulster's commitment to widening access to its courses
- Provide an opportunity for those people who are constrained by employment, by geographical location, or who are unable to attend conventional full time or part-time study programmes to get a University of Ulster Postgraduate award.

3 Issues

Currently the project team is evaluating various systems that support tutoring over the Internet. Based on evaluations carried out in similar projects, there are features that will be considered essential for inclusion in the selected computer managed instruction software.

3.1 Communication

Given that the Portfolio is being designed primarily for delivery overseas, we consider that in the first instance, asynchronous tutoring will be adequate. Taking into consideration time differences between students and tutors, it is unlikely that both groups will communicate synchronously, except in exceptional circumstances. However, asynchronous electronic communication tools such as electronic mail and discussion threads are perceived to be crucial to the success of the project. (Heywood and Cornelius 98) have identified that such communication tools promote a feeling of 'belonging' among students who are registered in a virtual class. (Paul and Brindley 96) also point out that the incorporation of good support mechanisms is crucial to the success of distance education courses.

Considering electronic mail, a useful feature would be the ability for the student to email a tutor or peer, *in context,* from every section of courseware while the system automatically includes the Uniform Resource Locator (URL) for that particular section within the body of the email message. The recipient is then in a position to click the URL and the section to which the sender referred in the email is launched - a great time saving feature.

One of the advantages of threaded discussion is that it can be used by tutors as a means of eliciting student response to various topics. Occasionally the material generated by these discussion threads may include aspects that the tutor had not considered while designing the course, and thus the material may be subsequently incorporated into future module revisions. In addition, this form of communication would require little effort on the part of the tutor, and could be a means of easily immersing students in the learning environment.

3.2 Access

Emphasis will be placed on course structure, and assessment, using text and graphics. (Heywood and Cornelius 98) have also identified that students' concerns include download times for course files, and actual duration of on-line study. Bearing this in mind, initially, the intention is to develop a course with small file sizes, thus facilitating access via low speed modems. Supplementary traditional material, such as video files, will be sent to the student. It is likely that such concerns will fade when the cost of technology and access to the Internet drop. However, in the meantime, the use of software such as Macromedia Director allows the development of animated interactive sequences that can provide an engaging stimulus while requiring considerably less download times than video files. (Riley and Hodgkinson 97), in early studies of students using an interactive multimedia package incorporating structured student guidance as part of their construction course, conclude that students consider such interactive systems to be a motivating and flexible means of self learning. They also state that such systems should be comprehensive in order to provide for the various learning styles exhibited by students.

3.3 Learning Environment

The learning environment created for the student will not only draw upon a state of the art computer managed instruction system, but will allow direct interaction between tutors and students by the use of short residential courses. The latter is seen not as an information transfer exercise, but one that promotes a 'deep approach' (Entwistle 95) to teaching and learning that can significantly 'add value' to the quality of the educational experience.

Considering the Internet aspect of the Portfolio, (King 98) makes several suggestions, based on evaluation of current applications, for enhancement of predominantly document orientated web based courseware. It is important that such courseware is not seen as simply an on-line page turning exercise. Students benefit from being engaged with the system. (Paul and Brindley 96) stress that one of the lessons to be learned from previous forays into distance learning is that students' individual differences should be taken into consideration when designing a course, in order not to produce an assembly line type of learning. To this end, we will include several self-assessment exercises, such as multiple choice, image map or list map exercises, which are automatically graded by the system. These will have the double advantage of incorporating interaction while providing students with instant feedback, along with direction to remedial or further tutorial material. Based on previous research into intelligent tutoring systems, carried out in the University of Ulster, (Hannigan et al. 97) significant effort will be expended on the provision of an *individualised* feedback feature. The software system chosen to 'host' the Portfolio, therefore, should be capable of supporting this.

4 Future Directions

This project is in its infancy, and our current goals are to develop course modules in a manner suitable for delivery over the Internet, to decide on suitable software for the delivery of such modules, and to positively deal with the issues we have discussed above. Although our first 'intake' of students is not due until March 2000, we anticipate that a good proportion of the Portfolio will be in place over the next six months.

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An Analysis of CD-ROM and Print Storybook Reading by Parents and Preschoolers

James P. Van Haneghan, Dept. of Behavioral Studies and Educational Psychology, UCOM 3705, University of South Alabama, Mobile, AL 36688, USA, email: jvanhane@usamail.usouthal.edu

Abigail Baxter, Dept. of Special Education, UCOM 3800, University of South Alabama, Mobile, AL 36688, email: abaxter@usamail.usouthal.edu

Despite the proliferation of Multimedia CD-ROM software aimed at preschoolers, there is little data on how children and adults interact with such software. Nor is there data concerning educational significance of such software. Hence, studies of how children and parents interact with multimedia software are of great importance. The goal of this paper is to examine parent-child interaction with CD-ROM storybooks and traditional storybooks to determine whether the interactions between parents and children using CD-ROM's are different from interactions between parents and children in joint book reading. Joint book reading has been found to be an effective context for the development of pre-literacy skills (Bus, Van Ijzendoorn, & Pelligrini 1995). Hence, comparisons of book reading and CD-ROM storybooks could provide insight into how CD-ROM software may impact literacy development.

Most of the previous studies of CD-ROM storybook reading have focused on school-age readers working with CD-ROM or written versions of storybooks (e.g., Matthew, 1997; Okolo & Hayes, 1996). Findings have been mixed. Some studies found that CD-ROM versions led to better comprehension (Matthew, 1997). Matthew found that students' retellings of stories were better when they worked with the CD-ROM. Others (e.g., Okolo & Hayes, 1996) have found that comprehension could possibly be hurt. Okolo and Hayes found that students spent a great deal of time clicking on animations, rather than focusing on the story.

There is virtually no research examining preschoolers' interactions with CD-ROM storybooks, even though many CD-ROM developers target preschoolers. Research on joint storybook reading suggests that there are several benefits to such activity (Bus et al., 1995). Children whose parents read with them are more advanced in language and pre-reading skills (Bus et al., 1995). Interventions that have targeted joint reading of books in children at-risk (e.g., Whitehurst & Arnold, 1994) have found that joint book reading improves reading and language readiness. We were interested in whether CD-ROM storybook reading had the same potential. Our goal was to study joint (parent-child) CD-ROM storybook reading, much like investigators have looked at joint reading of storybooks with preschoolers. We use examples from our investigation to ask what potential benefits there might be to preschoolers and parents jointly reading CD-ROM storybooks versus traditional print storybooks.

We report here on six four-year-old girls and their mothers as they worked together on two storybooks. The books were part of the Living Books Series produced by Random House/Broderbund. The Living Books were ideal to study since print versions of the stories accompany the CD-ROM versions. Hence the CD-ROM and written versions of the stories were comparable except for minor variations. The children and their parents varied widely in their computer knowledge. Three children had a computer in the home, and all of the children had used a computer. The children and parents were randomly assigned to read one of two stories on CD-ROM and one in a print version. The order of reading was counterbalanced. We examined, the children's comprehension, the time on the task, and examined differences in interaction.

We found that children and parents spent more time interacting with the CD-ROM than the book versions of the stories. However, the activities afforded by the CD-ROM did not seem to enhance comprehension or vocabulary. Children and parents simply did a great deal of clicking on each page of the CD-ROM to see the effects. For the most part, the effects were visual, unrelated to the story, and were done to for the "fun" of clicking. One child spent over an hour clicking on every single thing she could find on a page. The typical pattern of interaction involved the playing of the narration of the text on a page, and then, clicking on things until either the mother or child were ready to move the next page. Reading pages of the books involved the typical processes of book reading. The mother would read the page and sometimes elaborate on the story or vocabulary relating to the child's previous experience. Typically, the book reading took approximately 10 minutes, whereas the CD-ROM interaction lasted a minimum of 30 minutes.

Although based on a small sample, these findings raise some important issues about the role of CD-ROM storybooks in promoting emergent literacy. One element of the interactions with the CD-ROM's was the propensity for dyads to focus on clicking to see "effects". To the extent that clicking might introduce the child to new words, help facilitate comprehension of the story, or simply create a positive shared interaction with a parent, there would seem to be clear benefits to enhancing interest in stories and reading. Alternately, there were times that the clicking became the primary purpose of the interaction. While all of the four year olds in the study could correctly remember the story events, younger children who have not had much experience with storybook reading may comprehend less because of the change in task focus. Additionally, to the extent that clicking on something does not provide anything but a visual effect, the potential for learning vocabulary is limited. Two examples from one book used in this study, The *Tortoise and the Hare* (Random House/Broderbund, 1993), illustrate this issue. On page two of the book, clicking on various animals leads them to play musical instruments or sing. The animals are unrelated to the story, and unless a parent works on naming of the different animals, there is little in the way of vocabulary learning. For example, a parent might point to the squirrel and say "let's click on the squirrel". Their use of the word is facilitative of vocabulary, but because it is not really relevant to the story context, it might not be as well learned. There is nothing to anchor the squirrel to in the story. Additionally, the animals singing and dancing have the potential to distract children from the story and hurt their comprehension. Page six contains a more functional click with references to the Hare's different "moves" as he runs the race. The page lists and illustrates, with a click, the various ways of moving (e.g., skipping, sprinting, etc.). The clicking affords links to vocabulary that are related to the story and thus seems more facilitative of interactions that could increase vocabulary and comprehension. Hence, our analysis suggests both potentially positive and negative effects of using CD-ROM animated storybooks.

An additional issue concerning CD-ROM storybooks is their potential effects on the motivation to read among children. Do CD-ROM storybooks increase or decrease motivation to read? Children and parents working together on a CD-ROM version of a story seem to spend more time working together than when a parent reads a story. The children spend more time on task, and therefore, the parents have a greater opportunity to enhance literacy development. The special effects and animation provide a joint context that can facilitate parental mediation of language and literacy development. However, the presence of animation and special effects may make text versions of stories less interesting for some children. The only evidence we have for addressing this issue is our analysis of our own daughters' work with CD-ROM storybooks starting at about age three years and continuing to the present (they are now six years of age). While they request the CD-ROM books from time to time, they are far more interested in print text. Print text still, as many have pointed out, is far more convenient and portable. However, our children may be the exception rather than the rule in the sense that both of their parents are well educated and began reading storybooks to them very early in their development. Younger children and children whose parents have put less emphasis on storybook reading may differ in their motivation to work with CD-ROMs or print storybooks. Also, the sample included only girls and their mothers. Hence, there may be some gender differences to consider.

Overall, the data suggest that although CD-ROM story books can be used like print storybooks as a tool for developing language and literacy by parents, there are some differences in how CD-ROM's are used and some drawbacks to CD-ROM storybooks as they are presently designed. We would like to see more functionally designed storybooks that take include more functional "clicks" that are linked to the story rather than clicks that are simply distract and entertain.

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Teaching Multimedia Tools in a Constructionist Paradigm via the Web

JoAnne Davies
University of Alberta
3-104 Education North
Edmonton, Alberta, CANADA
joanne.davies@ualberta.ca

Mike Carbonaro
University of Alberta
3-104 Education North
Edmonton, Alberta, CANADA
mike.carbonaro@ualberta.ca

Introduction

The University of Alberta (U of A) Faculty of Education has undertaken a restructuring process with the goal of better preparing teachers to effectively integrate technology into their teaching. This paper describes the authors' participation in one project which is a component of this renewal process: the development of a teacher education course offering an introduction to educational media and instructional technology. This course emphasizes a constructionist approach to problem-solving with multimedia tools.

Although it is still important to understand how technology can be used to assist in the development and presentation of instructional material, one can also think about how students in grades K-12 can use technology themselves to construct a learning environment. The idea is simple, children construct their own multimedia material and in doing so "learn by doing." The children become multimedia developers and in the process they gain both content and process knowledge. This approach is only made possible by the continuous development of more powerful microcomputers and easy to use tools for constructing multimedia software. For this approach to work, teachers themselves must be familiar with the current technology that can be used to create multimedia material. Furthermore, teachers must also know how to obtain and organize content material, and how to design and develop a multimedia application.

Course Design

This course has two streams, both of which run concurrently. One stream emphasizes a survey of the existing technologies that can be used to create multimedia material. This is the pragmatic side, i.e., getting your hands dirty. For example, students learn simple things like how to: (a) scan a picture into the computer, (b) record audio and video into the computer, (c) use graphic tools, (d) use Computer Mediated Communication (CMC) tools, including the course website (http://www.quasar.ualberta.ca/edpy485dev), and (e) use a multimedia authoring system (HyperStudio). As byproducts of learning these tools they discover their potential for the development and presentation of instructional material. The second stream involves the student teacher acting the part of a K-12 student, representing knowledge by developing a series of small, theme-based multimedia projects.

Theoretical Course Design Considerations

Two important theoretical considerations concerning the role of computer technology in teacher education greatly influenced the course design. The first of these is the importance of early technology learning. Logan (1995) postulates that there are five languages presently being used to communicate and process information: speech, writing, mathematics, science, and computing. In the course of history, each language evolved from its predecessors due to the need to address more complex information processing problems that were associated with economic and cultural advancement. Currently, the first four levels of language are integrated from early education onward. However, Logan argues that most students do not have the opportunity to learn the fifth level properly or early enough.

The second theoretical consideration was that computer-based tools and learning environments (e.g. databases, spreadsheets, semantic networks, computer conferencing, hypermedia construction, or microworld environments) can serve as cognitive tools or extensions of the mind. With the use of such "Mindtools" (Jonassen, 1996), learners can enter an intellectual partnership with the computer, in order to access and interpret information, and organize personal knowledge. This moves in a very different direction from traditional computer use in education. In the past, the emphasis was on computer literacy (learning <u>about</u> computers) and computer assisted instruction (learning <u>from</u> computers). The application of "Mindtools" involves students learning <u>with</u> computers (Jonassen, 1996).

Conclusions

Multimedia projects can improve educational outcomes by enabling students to represent information using several different media, to link and organize information in many meaningful ways, to draw knowledge and experiences from a wide variety of sources, to practice problem-solving and decision-making, to achieve high self-esteem and to become more self-directed. Such projects include a wide variety of activities and skills which groups can work on effectively over an extended timeframe. They involve a substantial amount of work, open-ended assignments, theme-based activities and interdisciplinary activities. Multimedia projects require and reward good planning and execution skills and students are motivated to create a quality product because a wider audience may view it (Agnew et al., 1996).

As student feedback indicates, the constructive, collaborative, student-centred nature of this course has proved to be a very engaging learning environment. Most pre-service and in-service teachers indicate that they feel more confident about integrating technology into their teaching after completing this course. Course observations have produced support for the use of information technology as a cognitive tool in today's classrooms. Applications such as hypermedia projects or CMC appear to have the potential to more powerfully impact student learning than traditional uses such as drill-and-practice. "Mindtools" elevate educational computing from addressing only simpler skills such as memorization into the realm of complex reasoning processes such as synthesis and evaluation. Hopefully this course furthers the "mindtools" cause by providing teachers with a glimpse of how information technology can contribute to the creation of engaging and relevant learning environments.

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ED-MEDIA? ED-TELECOM? Or Both: A Strategic Plan for a University Technology Center

Jho-Ju Tu, Instructional Technology Center
Georgia Southwestern State University, Georgia, USA
tu@canes.gsw.edu

Hsin-Chu Chen, Department of Computer and Information Sciences
Clark Atlanta University, Georgia, USA
hchen@diamond.cau.edu

Introduction

The scope of the definition of educational technology has changed along with the development of advanced technology over the years. Many educational technology centers at universities were only used to serve as warehouses for distribution of audio and video media in the old times. With the diversity of today's computer technology, a modern educational technology center at a university setting can offer services to cover ED-MEDIA and even ED-TELECOM, in addition to its traditional roles. The purpose of this paper is to reexamine the dimension of educational technology for the mission a university technology center can carry.

New Role of a University Technology Center

The rapid progress of the use of technology in education has made major changes in the ways that students learn and teachers teach. To create an enriched learning and teaching environment to meet the challenges resulting from the development of the advanced educational technology, a university technology center can not serve solely as a distribution center for teaching-aid materials but need to extend its mission to provide the necessary organizational infrastructure, hardware and software support for the integration of technology across the curriculum and to offer pedagogical and instructional training for faculty and staff members to use new technology to enhance their teaching or daily operations (Georgia Southwestern State University, Technology Committee, 1998). Furthermore, the center must also assist faculty and staff in developing positive attitudes towards new technology, add new strategic visions for technology to the campus strategic plan, and provide consultation and active involvement to support the movement as an active participant in the global electronic community.

Decentralization of Instructional Technology

Modern instructional technology involves a great deal of communication infrastructure, computer hardware and peripherals, communication and application software, and presentation equipment. As a result, the complexity of providing efficient and effective services to faculty and staff members has dramatically increased and, therefore, approaches to establishing a foundation and to building a technology infrastructure must be carefully studied. There are basically two approaches: a centralized approach and a decentralized one. In a centralized environment, there is normally a single unit in the university that manages the operations and controls the access to the resources. This approach works well in a traditional setting since it does not require a great deal of diversified expertise to provide the service and the demand of flexibility is not high. In a rapidly changing high-tech field such as the current instructional technology, however, the diversity of expertise and the demand for flexibility in providing the service have made the centralized approach less efficient. Due to the complexity of the existing and forthcoming new technology, we feel that decentralization of the basic technology is vital to the success of the operation. To achieve this goal, basic instructional technology stations consisting of VCR's, TV's, monitors and projectors should be distributed and put directly in the hands of faculty and staff to make the use of the technology on campus flexible. This decentralization can also be applied to include computers and networking equipment to allow for easy access to outside world via the Internet.

Use of Satellite Technology, TV Broadcasting and Distance Learning Programs

Satellite technology has found several important applications, including television distribution, long-distance telephone transmission and private data networks. Currently, there are many national and state educational programs and live teleconferences broadcast via satellites. The Public Broadcasting Service (PBS), for example, provides many episodes for "Technology in the Classroom", "Next Steps in Technology", "GED Classroom", "Classroom Contact", and "Real Science", just to name a few. It is, therefore, very desirable to have downlink capability to receive those programs over the air to enrich educational resources, to assist teaching in the classroom, and to enhance faculty and staff development. On the other hand, maintaining and operating a TV station on campus offers the ability for a university to provide broadcasting services, including educational and entertaining programs downlinked from the satellite system, to not only the students, staff, and faculty on and off campus, but also the neighboring communities. It can also be used to train students with mass communication major to gain experience in the production, programming, video and audio editing, and broadcasting of TV programs.

Made feasible by the availability of video conferencing networks and the Internet technology, distance learning has several advantages over traditional classroom learning, such as flexibility, convenience, and adaptability. It is flexible because learners can take lessons at the time they feel most comfortable. It is convenient because taking lessons is, to a great extent , geography-independent. It is adaptable because learners can adjust their learning speed and path based on their progress. These advantages are especially apparent if the learning takes place on the Internet using the WWW technology. Although there are still arguments on the definition of distance learning, distance learning has already had a impact on the way instruction is designed and delivered and will continue to affect the filed in a significant way (Reiser, Ely, 1997). Accordingly, it has become essential for an instructional technology center to establish distance learning programs using both video conferencing networks and the Internet. This involves not just establishing distance learning classrooms for the students, staff, and faculty to use, but providing the capability and environment for faculty members to develop their course material for distance learning and to conduct online examinations, online survey, and online enrollment (Tu, Babione, and Chen, 1998) over the Internet.

Conclusions

Judging from the rapid progress in the computer hardware, software, and applications, in the communications networking technologies, and in the development of WWW, it is not difficult to envision that educational technology will continue to grow and, very likely, lead us to an even newer world in the future. If we are the practitioners in this field, what we need to do is to open our eyes for the new trends as long as it opens some avenue for teaching and learning. There is no need for us to limit ourselves to just what are available today.

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The Influence of Multimedia Lesson Structure & Learning Styles on Prewriting Skills and Composition

Gayle V. Davidson-Shivers, Dept. of Behavioral Studies & Educational Technology, University of South Alabama, Mobile, Alabama, gdavidso@jaguar1.usouthal.edu

Barry Nowlin, Dept. of English, University of South Alabama, Mobile, Alabama, bnowlin@jaguar1.usouthal.edu

Michael Lanouette, Southeast College of Technology, Mobile, Alabama, mlanouet@edamerica.com

Introduction

Most of the recent research investigating the effects of multimedia on student writing has converged on the computer's capability to process text (Hartley, 1993). And, to date, much of this research has centered on the use of word processors to transpose text or on the use of style checker applications such as *Editor's Assistant* (Dale, 1990). Although new programs continue to be developed, development and use of multimedia or computer applications have not kept pace with emerging cognitive theories about composition as a goal-directed, problem-solving activity (Flowers & Hayes, 1981, 1977; Scardamalia & Bereiter, 1986).

Most of these modern composition theories encourage the use of some version of prewriting activities such as planning, translating, and reviewing. Often to aid the students with these prewriting activities, heuristics are incorporated into the instruction. These strategic exercises ask students to envision solving specific communication problems (Flower & Hayes, 1981). However, little research using multimedia for teaching prewriting skills as a heuristic can be found in the literature. Therefore, these researchers speculated whether teaching such heuristics via a multimedia environment would be successful and for which type of learner.

These learners vary according to learning styles, which can be an important variable in cognitive processes and perceptions and use of heuristics (Rasmussen & Davidson-Shivers, 1998; Davidson, 1990; Kolb, 1984). Kolb's four learning styles are based on active or reflective processes and concrete or abstract perceptions when learning. *Divergers* tend to use concrete conceptualization and are reflective processors; *Accommodators* rely on the concrete concepts, but are active processors; *Assimilators* rely on abstract concepts and are reflective processors; and *Convergers* also use abstractions, but are active processors of information. In addition, recent studies using various structures within multimedia environments for various learners have yielded mixed results (Rasmussen & Davidson-Shivers; Lin & Davidson, 1996; Kinzie & Berdel, 1990). Rasmussen and Davidson-Shivers reported a significant difference in the interaction of structure that allowed various learner control and learning styles on performance as did Lin and Davidson in their study on structure and cognitive styles. However, other studies have not.

Therefore, using a multimedia lesson on prewriting heuristics, the purpose of this study was to investigate learning styles and multimedia structure (random and hierarchical) on writing performance of undergraduates. Of primary interest, the researchers asked does either structure affect composition quality and do learning styles influence writing performance? As a secondary focus, the researchers collected data on student demographics, writing and computer skills, attitudes as well as time spent on the lesson.

Methods

Subjects

Forty-seven students in an undergraduate composition course at a regional university in the Southeast participated. There were equal numbers of males and females with the majority of them being freshmen.

Materials

The researchers designed a multimedia lesson on the prewriting heuristics of brainstorming and outlining for developing a written composition. This lesson was developed using Authorware and Windows-based computers. The content and instructional strategies were the same for both treatments. However, the lesson had two versions based on how the lesson was structured. The hierarchical structure (HS) allowed students to move through the lesson in a sequenced manner while the random structure (RS) allowed students to choose any parts of the lesson they wished to see and in any order. Both versions of the lesson allowed the individual to spend as much time on any given section as they desired. The multimedia program was designed to collect data on the amount of time each individual spent on the lesson and its subsections for both RS and HS treatment versions as well as to indicate the order of the path chosen by those in the RS treatment version.

Procedures

Prior to the study, students completed a demographic survey and an attitudinal questionnaire about their computer and writing skills. They also completed the Kolb's (1981, 1984) Learning Style Inventory. Students were then randomly assigned to one of the two treatment lessons. At the beginning of the lesson, the researcher read written directions stating that three in-class assignments would be given: brainstorming a list of ideas for a composition, outlining based on the brainstorming, and composing an essay. Students were able to work at their own pace using the multimedia lesson during the regularly scheduled class periods for one week, and were told their compositions would be due at the end of the last class period and would be graded.

Results

Researchers, having been trained on a rubric for grading quality in writing, critiqued and scored the compositions (with an interrater reliability of .70). Results of the study indicated no significant differences in performance between the two treatments; however, the RS group completed the lesson faster than the HS group without a qualitative difference in their compositions.

Although not statistically significant, there was a trend toward the Divergers writing better compositions than the other three styles. In comparison, Accommodators did less well on performance; furthermore, their attitudes about the lesson and the writing assignment were less positive than the other styles; again this finding did not reach statistical significance.

Discussion of Results

Although the results of the study were not as anticipated by the researchers, they may be of importance with regard to using multimedia for teaching heuristics about writing. First, even though type of structure did not achieve significant difference, the RS subjects completed the heuristics lesson faster than the other group. This may suggest that students who select their pathway through the lesson may complete it more quickly without the loss of writing quality. Additional research is needed to support these findings as well as investigate the relationship between prior writing experience and prewriting skills instruction. Additional research is also needed to verify whether learning styles influence writing performance and attitudes toward writing.

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Teaching Multimedia On-Line

Roderick Sims
School of Multimedia and Information Technology
Southern Cross University, Coffs Harbour NSW 2457 Australia
rsims@scu.edu.au

Julian Melville
School of Multimedia and Information Technology
Southern Cross University, Coffs Harbour NSW 2457 Australia
jmelvill@scu.edu.au

Michael Morgan
School of Multimedia and Information Technology
Southern Cross University, Coffs Harbour NSW 2457 Australia
mmorgan@scu.edu.au

Introduction

Southern Cross University offers a Bachelor of Multimedia program to provide students with comprehensive study in the field of multimedia, taking advantage of specialisations within teaching units to consolidate the multi-disciplinary nature of interactive multimedia. On completion of the course, students would be expected to have (a) developed comprehensive skills and knowledge in the foundations of interactive multimedia, (b) demonstrated skills in the design and development of multimedia applications incorporating digital media; and (c) undertaken a major study in one area of the multimedia field. The locations http://edmm.scu.edu.au/ and http://multimedia.scu.edu.au identify the teaching and marketing web-sites of the multimedia program. There were several reasons for moving towards on-line delivery of multimedia content, including an increased focus on international delivery of courses, a large cohort of mature and part-time students, changing socio-economic conditions and an overall commitment towards more flexible delivery within the teaching unit, the School of Multimedia and Information Technology.

With the overall goal of being able to offer the full undergraduate multimedia program in a flexible mode of study from 2000, a phased program of preparation for on-line delivery was commenced during Semester 1, 1998. The initial phase of this process involved introducing the on-campus students to on-line access of materials by providing the majority of unit resources and teaching materials on the web, even though classes continued to be delivered in the traditional internal (face-to-face) mode. Additional preparation for the task of adopting an on-line strategy consisted of informal interviews with students to discuss the structure that would be most beneficial to their learning, assessment of other similar implementations, a review of similar teaching sites already implemented and a review of the overall strategy of the multimedia program.

Design

A structure for the site was designed to include a news area, unit statements, staff contact details, the teaching timetable and links to each unit being taught. For the individual units, information included a semester outline, links to web-based readings and library resources, lecture notes and weekly exercises, on-line tutorial material and assessment specifications. One of the design parameters was to restrict access to those students enrolled in the program. The two main options available were to restrict access by network address or by username and password; initially the username and password option was ignored because of the potential administration problem of maintaining password lists. However, after determining that students could conceivably wish to access the site from anywhere in the world, making network address restrictions impractical, the second option was chosen. Fortunately the web server being used (Novell Web Server 3.1) allowed the securing of web sites using existing IntraNetware account information, which has to date worked well in practice.

The design of the web pages themselves was driven by several main goals, chiefly the desire to make a site that was easy to navigate and pages that were fast to download over a modem. The wide range of client machines, operating systems and web browsers that could be used to view the site meant that the HTML code had to be simple and straightforward, avoiding browser-specific tags and scripting languages. Many of the conclusions of Nielsen relating to site navigation and page design were found to be very useful in achieving these goals (Nielsen & Sano, 1994; Nielsen, nd). The resulting site features minimal use of graphics, with techniques such as table background colours being used instead. Pages are identified with the name of the author, the date first published and the date of the most recent modification to indicate to students when material has changed. An hierarchical navigation system at the top of each page indicates where in the site structure the student is currently browsing, with links on the left-hand-side to the top of each significant area of the site. Links to pages that are within the current site structure are marked with blue arrows, while links to other web sites are marked with red arrows; links to non-electronic resources are marked in black.

Development and Assessment

Initial production of the site was implemented using a template-based publishing system (Userland Frontier), which enabled rapid development of the structure of the site. Because the overall look of the pages is governed by these templates, and the content of the pages is stored separately, changes to the whole site can be implemented quickly and easily. The original web site incorporated most of the features of the original design, the major omission being the news area. As electronic mailing lists were already heavily used within the multimedia program to communicate with students and disseminate news, it was decided not to create yet another place for news to be published, and instead to use the web site to archive postings to the mailing lists. The archival feature is to be incorporated into the next major revision of the site.

Initial assessment of student feedback to the site revealed overall positive results. In a rating scale from 0-5, all major factors were rated favourably, with the possible exception of the *On-Time* factor. This highlights one of the major issues confronting the development of web-sites in general and on-line learning sites in particular, that of regular and up-to-date maintenance. Once the student cohort becomes entrenched in using on-line materials, any delay in access is noted almost immediately!

Overall, the Multimedia On-Line site has been used as the primary information resource for most of the twenty units taught during the first and seconds semesters of 1998. While there were some difficulties in producing and publishing the information in a timely fashion, many of these were related to a lack of suitable writing tools for on-line publishing. The traditional software packages used for writing have many problems when they are used to write material intended for on-line delivery, but as this is an area of significant change, it is anticipated that such tools will mature over time.

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The Electronic Learning Environment (ELE) for IT-based Course in Hong Kong

MAK John Chi-sang, Assistant Professor, The Open University of Hong Kong, jmak@ouhk.edu.hk
YUEN Kin Sun, Head of ETPU, The Open University of Hong Kong, ksyuen@ouhk.edu.hk
CHUNG Siu Leung, Associate Professor, The Open University of Hong Kong, slchung@ouhk.edu.hk
CHOW Linda, Publishing Manager, The Open University of Hong Kong, lchow@ouhk.edu.hk

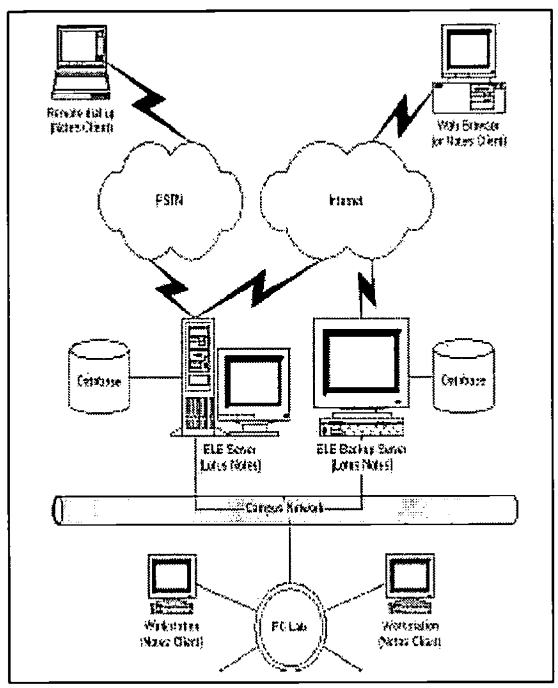
Abstract: This paper describes in detail how an IT-based course is designed and delivered using the latest information technology (IT) in Hong Kong. Based on Lotus Notes, an electronic learning environment called ELE is developed and used in an IT-based course as an alternative for delivering distance education. The ELE runs on both Windows and Macintosh, caters for communication, collaboration and course co-ordination purposes, and acts as a transportation vehicle for distributing course materials. Evaluations of the ELE are conducted throughout the course. Very encouraging results are obtained.

Introduction

The Open University of Hong Kong (OUHK), formerly the Open Learning Institute of Hong Kong (OLI), is the only distance learning university in Hong Kong. Currently, most OUHK courses are print-based. Communication between students and tutors is carried out through telephone and correspondence, and assignments are submitted and returned by mail. A number of initiatives along IT strategy in distance learning were started at the OUHK in the past years. This paper reports the first experience of online course teaching and learning in the OUHK.

The Aims of this Research

In 1997 an OUHK research project was initiated with the aim of designing, developing, delivering and evaluating an electronic delivery system for distance students in Hong Kong. It is expected that this system not only provides an alternative for the delivery of course material but also fosters a better environment of communication and collaboration between students, their tutors and their peers.



Research Methodology

An IT-based course is selected for pilot purposes. Students are first asked to opt for the '*electronic*' or '*print*' version of the course. Sixty (out of 120) students opted to take part in the pilot study and they are divided into two tutorial groups with 30 students each. During the course, they studied the course online and did not receive any printed materials. Three electronic questionnaires are sent to students on: (a) background and initial reaction to the electronic course delivery system, (b) usage characteristics and problems encountered, and (c) summative evaluation at the end of the course. Interviews are also conducted with a sample of students and tutors.

The IT-based Course

The course selected for the project is *B321 Advances in Information Technology*, which aims to develop students' knowledge and understanding of current and emerging IT, and their capability to identify, evaluate and apply these IT products to appropriate business situations. Topics include OA (Document Management and Groupware); DBMS; OO Visual Development Environments; Networking; Open Systems and C/S Computing; the Internet and Electronic Commerce; and Knowledge Work Support Systems.

The ELE Architecture

The electronic course delivery system developed (based on the Lotus Notes R4.5) for this project is called the Electronic Learning Environment (ELE). The server is a Pentium-based PC, featured with 64M RAM and 2GB hard-disk space (see the network infrastructure of the ELE). The backup server, also configured with Lotus Notes R4.5 and connected to the ELE server via a fast Ethernet, runs an agent program to replicate all the ELE databases every 30 minutes. In case of systems failure, the latest backup databases can be reloaded to recover the ELE server. The ELE has been further developed to allow Internet access with proper authentication. The ELE components include **Course Materials, Assignments, Discussion, Information, Evaluation**, and **Personal Folder**.

Major Findings

Student Background – of the 60 students, 46% are married. The majorities of the students have sub-degree qualifications, and are working in the technical (35%), administrative (18%), and business (18%) professions, with monthly salary of US$2,000 or above (68%). They have access to a desktop computer, with Pentium or higher processor running with MS Windows 95, more than 16 hours per week. All students are equipped with at least one telephone line at home and 30% of them have two. Overall, the students found the Lotus Notes and ELE installations easy and straightforward. Some minor problems were encountered initially but they were manageable.

Usage Characteristics and Problems Encountered – although the majority of students found it more effective to print out the course materials to study, a few students generally preferred to study on-screen. Interestingly, not many students posted but frequently read messages in the Discussion forum. The arrangement of the assignment submission electronically is frequently praised. Overall, students found the ELE system easy to use, and preferred ELE to the print-based mode.

Summative evaluation – the proportion of students who indicated that they enjoyed studying the course is 82% while another 18% of students indicated that they are neutral or of mixed option. The electronic course features that students liked most the electronic course are 'Email', 'Discussion forum', 'Electronic assignment submission', 'Search engine', and 'Advances in IT'. While the features that they liked least the electronic course are 'Computer dependence', 'On-screen study', and 'Printing course materials' respectively. There are 5 assignments and a final examination for this course. The electronic mode students performed as well as the printed mode students. In particular, they performed better in terms of the number of 'Pass 1' and 'Pass 3', and the overall passing rate in the course.

Discussion

The ELE offers better assignment submission process – it is validated that the ELE has helped a great deal in the assignment tracking, submission as well as the due date extension approval process. This shortens the assignment submission cycle from 2-3 weeks to a 1-2 hour.

The ELE acts as a transportation vehicle for distributing course materials – as an extension of the study materials, it provides learners with pointers (such as URLs), presentations, images, audio/video clips, animations, exercises/workshops, simulated laboratory environment, etc. which are almost impossible in traditional print-based materials. As an information delivery mechanism, it facilitates assessment, discussion, Q&A, etc. It has also enhanced offline communication on administrative and ad-hoc matters.

The ELE is used to enhance distance education – instead, the ELE should not be aimed at replacing the traditional print-based study materials in the sense that the current display technology and user interface do not seem to offer a better alternative to print-based study materials. Besides, the traditional mode of study is location-independent while an access to the computer (and occasionally the network) is required for the ELE. In addition, psychological barriers need to be overcome, as the ELE does not satisfy the sense of possession of the learned knowledge as everything exists in an intangible form.

Lotus Notes vs. WWW – Notes offers an '*offline*' communication. However, it is location-dependency as a user identification file (*user.id*) and the study materials, which are usually stored inside a predefined machine, are required. WWW which offers a '*real time online*' solution is also a good alternative platform. It is potentially more convenient as no set-up is required and students can access the ELE server from any location. According to our research, students are typically equipped with only one telephone line at home. They may need to resolve conflict regarding with other family members using the telephone line for a real time access.

The ELE training and supports are necessary – a tutor has to know more than the students on the use of the ELE as he or she is probably their first contact for problems. Training for tutors becomes mandatory. A well-organised technical support mechanism providing support at night time is critical as most problems occurred at night that is the peak time for students and tutors using the ELE system.

Conclusion

In general, we found that the objectives of the research project were achieved. An electronic course delivery system was designed, featured with six major components: Course Materials, Assignments, Discussion, Information, Evaluation and Personal Folder. An IT-based course was converted into Notes database document format and delivered to students electronically. Very encouraging results are obtained. Experiences gained in running the online course are useful in the subsequent offer of other electronic courses in the University.

The Intelligent Test Toolkit: Story/Concept Generator

Michael Yacci
Associate Professor
Information Technology
Rochester Institute of Technology, USA

Story/Concepts

A *story/concept* is a concept that involves a situation rather than an object. Many concepts in the social sciences involve more than the examination of a particular object--rather, they involve complex actions and events often involving human actors. These concepts are the basis of many social science principles. For example, the field of group dynamics uses the related concepts of *constructive conflict* and *destructive conflict* in the analysis of group interactions. In teaching story/concepts, many teachers will use "word problems" that explain a situation to a student and asks the student to classify the word problem.

Such a word problem might look like following:

> Bill and Jim are working on a project for the Chain Division of General Bicycle, Inc. Bill suggested that they use a titanium chain for the project, but Jim was against the idea. Their dialogue went like this:
>
> Bill: "I think the titanium will be more powerful--provide added strength."
>
> Jim: "No--a thousand times no! You have the worst ideas--always. Can't you think?"
>
> Is this an example of *constructive* or *destructive* conflict? Why?

Story/concept examples are time consuming to create; consequently a teacher may provide only limited examples. For some students, a few examples may be sufficient, but others may need additional practice in classifying the concept. Therefore, a tool that could help teachers create a large number of story/concepts, quickly, would be useful.

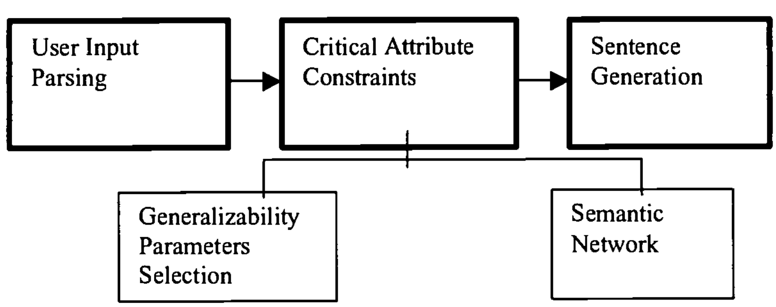


Figure 1. Components of the Story/Concept Generator

The Intelligent Test Toolkit Story/Concept Generator

The Intelligent Test Toolkit Story/Concept Generator (SCG) is a natural language text generation tool, designed to take a single story/concept example and to generate many parallel story/concept examples. Specifically, it (a) accepts user input, in the form of a paragraph, (b) prompts the user for the critical attributes of the story/concept and the degree of generalization and (c) creates as many parallel story/concept examples as possible, given its current knowledge base. These activities coordinate with three general components in the SCG as shown in Figure 1. There are four screens within the SCG that represent the functions described above.

1. Parser Screen for User Input

The user enters information into a Parser Screen that allows for free-text input. When the user has finished entering the story/concept example, the story is parsed in several different ways. First, the parser is seeks the verb in each sentence and also all *content words*. Harris (1985, pg 322) describes content words as nouns, verbs, adjectives, and adverbs. Verbs are used to recognize the *conceptual primitive* (see Schank & Abelson 1977) involved in the sentence. Each primitive in the story is added to a *discourse structure* list, that keeps track of the order of the sentences.

2. Generalizabilty Parameter Screen

The Genralizability Parameter Screen (GPS) is the first of two areas that are used to limit and understand the degree of generalizability of the story/concept. The GPS lists each content term in the story/concept. It then prompts the user to answer questions about the desired degree of generalization of each term.

All knowledge for the SCG is contained in a knowledge base using a semantic network representation. The knowledge base is initially searched for hierarchical data (links labeled "a-kind-of"). Because terms may be members of several categories (a car is a kind of vehicle, is also a kind of gift, and is also a kind of status symbol), users must clarify the "tangled" induction (Holland, Holyoak, Nisbett, & Thagard 1986).

3. Semantic Network Screen

Certain key elements in the story/concept have relationships that must be preserved while the hierarchical inference occurs. These relationships are then used throughout the new story/concept example. A semantic network tool allows users to create an ad hoc semantic net of the relationships that must be preserved as new story/concept examples are created. A search and match function attempts to find parallel structures in the knowledge base.

4. Sentence Generator Output Screen

The Sentence Generator screen uses the decisions that were made on previous screens to re-construct a series of parallel story/concept examples. The number of possible parallel story/concepts is limited to the data stored in the knowledge base. Ideas relating to discourse structure are relatively unexplored in this tool. It would be interesting to explore an "understanding component" to the SCG that could attempt to "understand" the story's goals with a richer internal representation. This could lead the system to create alternative discourse structures to convey that information.

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SmartSearch as Information Database for Virtual University

Shirabe Ogino*, Ng S. T. Chong+ and Masao Sakauchi*
* Institute of Industrial Science, University of Tokyo, Japan
+ Institute of Advanced Studies, The United Nations University
ogino@sak.iis.u-tokyo.ac.jp

Introduction

Currently many approaches are suggested to achieve CAI in a networked environment such as the Internet. They all try to enhance and make more efficient the physical components of the learning environment on campus by creating a digital infrastructure that has come to be known as the virtual university. UNU in collaboration with IIS has launched the "Virtual University" project to jointly develop new technologies for instructors/students on the Internet. In this paper, we focus on a sub-component of the project that attempts to provide support for the full cycle of organizing and developing education on the Internet, from registration to curricular development, and from learning to student evaluation.

The problems found in the past

Even though CAI software is fabricated very well these days, not all of them are based on the goal of improving the quality of the education nor on the methodologies specially studied for CAI software. Besides problems of quality, not all instructors are happy to use the software due to two reasons. One is a problem of teaching style and the other is a course material problem. CAI software does not always fit the instructors' needs nor his/her style of teaching. Usually the software is produced based on the teaching methods of one particular instructor. It works very well only when either the instructor is a programmer or the instructor has his/her own programmer to modify/update the program for his/her needs. This scenario rarely happens in the real world. Some software developers try to offer authoring tools to cope with this problem. However, most instructors do not have enough time to learn how to use the tools, and then collect or create multimedia contents. It is not cost-effective even for skillful instructors to create multimedia data by themselves, and multimedia data sources on CD-ROMs are limited in quantity. These are the reasons why CAI software is not becoming very popular among instructors.

Here, we have a proposal that leads to the solution of the problem above. The Internet is a treasure box of multimedia data sources. If we have an effective tool to find course materials in an intelligent manner, one of the problems is solved. If we expect the software to be a tool to help instructors teach rather than a substitution for conventional textbooks, we can see the solution for another problem. This is the role of SmartSearch in the Virtual University project.

CAI with SmartSearch

SmartSearch is a web-based search engine classified as "Meta-Search Engine." The well-known example of Meta-Search Engine is the Internet search feature of "Sherlock" of MacOS 8.5. The web-based example is "Metacrawler" which works very well. Meta-Search Engine is an intelligent state-of-the-art search engine (SE). Conventional SEs, web-directory service SEs and robot-driven SEs, have a lot of problems due to their structure. The main point is the relevancy of the result with users' input. The Meta-Search Engine focuses on the improvement of this relevancy rate, and uses these conventional SEs by sending queries to them in the background. This system eliminates the costs of building up a new SE while achieving a higher relevancy rate with less waiting time. The effective ranking/re-ordering techniques of the results are studied in Meta-Search Engines. The main point is the *relevancy of the output* and not the *size of the main database*. Therefore, the key to "Meta-Search Engine" is "re-ordering."

Our SmartSearch claims to perform better than these examples by featuring weight adjustment techniques. The following are the factors we count to retrieve relevant data:

- The number of keywords appearing in the title
- The number of keywords appearing in the main text
- The number of keywords appearing in the URL
- The relevancy information returned from conventional search engines
- The number of URLs which share the same web-server
- Whether or not the keywords are jargon which can specify the area the user is looking for
- The type of search engine which returned the link
- The host type (e.g. edu, com, net, etc.)
- The length of the URL

After SmartSearch retrieves the actual HTML from the site, it will calculate the relevancy score for each link. Ordered by this score, the new list of relevant links is shown to the users. This system works very well with ordinary keywords, and we are enhancing its features especially for CAI use of handling multimedia data.

As we proposed, SmartSearch will be able to solve one of the big problems of current CAI software. Instructors will have fewer troubles using CAI software and finding digitized data, as we all hoped for in the past. This idea can be applied in two ways. One of them is to prepare course materials: a sub-component for conventional CAI software is to help the instructor produce his/her own digital textbook. Another is to help instructors actually teach in class: SmartSearch can be used online as a dictionary or as an encyclopedia which has accumulated knowledge of everyone in the world. Also, students can take advantage of this system. In the past CAI software, all system components including the authoring tools are for instructors who are supposed to be the only people who create materials. Although the conventional hardcover textbooks are made by educators, the students of the next generation can edit their own references. This tool is also useful for students to find relevant information for self-studying.

Conclusion & Future Work

Again, collecting/building up course materials is not a simple task. If we want to automate this task, we need something intelligent. We can use SmartSearch to gather information in order to skip first stage. The collected data at the first stage may need modification for teaching use, but should help instructors considerably. The Digital Library of UNU, where the digital information of the world will be served by SmartSearch, will greatly facilitate inquiry-based learning. For digital libraries to be useful, SmartSearch will allow users to access quality information more efficiently, and to make such information easier to search for.

Increasingly many universities around the world are taking advantage of the wide accessibility of the Internet to deliver educational contents online. Mobile computing, building upon the global connectivity of the Internet, adds a new dimension to the learning process. In particular, it gives users the illusion that their computer-mediated learning environments are ubiquitous. Users can continue their learning applications irrespective of the users' physical location and the computer being used for the task at anytime, right down to the last mouse-click as when last accessed. Under this model, data and/or applications follow users wherever they go. However, the past approaches of virtual classroom, library, and laboratory do not take into account the mobility of the learner in most cases. In our Virtual University project, this ubiquitous learning environment is an important element.
SmartSearch will be enhanced by the feature for distant-learning. Wherever the user is, the software will download the last state of the search and user's interests/preferences.

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Evaluating a Simple Realization of Combining Audio and Textual Data in Educational Material.

Making Sense of Nonsense

Robert Grimm
grimm@uni-paderborn.de

Markus Hoff-Holtmanns
frs@uni-paderborn.de
Computer Science and Society
Paderborn University
Germany

Introduction

In our workgroup of "Computer Science and Society" at the University of Paderborn lectures are usually presented with Powerpoint slides. Afterwards these slides are made available to the students of this lecture within our local Hyperwave-Server and Teaching Environment (Engbring, Schwolle 1997). The content of these presentations is highly condensed and the students are advised to make their own notes and comments during the lessons. Experience showed that most students lack the key qualification to follow the different branches of argumentation given by the professor and to write down their own notes, deciding online what makes sense and what is nonsense.

As we saw the problems of the students with grasping intention and contents of the lectures, we had to find a way to give them a second opportunity to understand the lecture and to support the learning process. This required a more differentiated form of course material. We decided to record the whole lecture, audio, video and slides, and to make it accessible for the students. We thought it useful for understanding the intention of a lesson to *"re-listen"* to the spoken word of the lecturer. But in our opinion it was not necessary to view the video because it is not very expressive in itself. The experience of "Authoring on the Fly" (Bacher, Ottmann 1996) showed that video did not improve the learning process, so we decided to use only audio. For fast access the audio-streams had to be compressed and linked to the slides of the original course material. So any student not quite understanding the contents of one slide could download the original spoken lecture by internet and replay it at home or at a workplace at the university.

We were convinced that this was useful because our professor gives the students many different examples during one lesson for better understanding. This approach to expand the amount of information available on a lecture had an advantage to writing down long text passages, because the recording of audio is done on the fly. The only work was to cut it up in usable pieces and connect these semantically as well as physically to the existing slides. Here it seemed reasonable to use short pieces of maximum 10 minutes for better motivation and precise navigation.

Development of an Effective Technical Realization

The actual recording of the lectures was done by using readily available tools. We used a standard 8mm Camcorder with an external microphone. For archiving purposes, we first transferred the recordings to VHS videotape. Afterwards the audio of the recordings was digitized by an audio connection to a standard sound device of a PC. After several revisions it proved to be most efficient to permanently install all the needed equipment in one transportable compartment. This way the recording, archiving and digitizing was all done "on the fly" during the lecture in one go. The resulting audio-files still had to be remastered. First it was necessary to erase the rather high noise level from the audio files. The students present at the lectures were not totally silent and noises like air conditioning and chairs and the like were not to be dismissed. After that the volume level had to be adjusted, because we could not place the microphone directly in front of the lecturer. And lastly we had to reduce the files in size. One hour of lecture resulted in about 160 MB of data. After some considerations about availability, reduction factor and performance we decided to use MPEG I Layer 3 (MP3), which allowed for data compression of about 1:14 (which left us with about 20 MB for one 90 minute lecture including slides and compressed audio). That way the audio files became possible to handle by internet. All this development was done during the course "Computer Science and Society".

Evaluation

After finding an easy way to record a lecture and producing the improved course materials, two different approaches to use these were developed. One was to apply the course materials to a distance learning course at Potsdam University. The other was to use the recording technique to accompany a second lecture course, "Softwareergonomie" at Paderborn University.

For the distance learning course at Potsdam University we used the audio files in addition to the lecture slides. The contents of the course where identical to those of the on campus course "Computer Science and Society", just that the attendants had to retrieve all their material by internet. Because of the big quantity of audio files we selected only parts of them which still amounted to about 150 MB. This may be the reason why an evaluation (Hoff-Holtmanns 1999) showed that from the 36 students only 30% where able to download and use the audio-files. Of these 72% made effective use of about half of the recordings. The other 28% actively used more than 60% of the recordings. This allows the conclusion that given an easier opportunity to access the files needed, most students would make use of them and a satisfying number would use them to support their learning process. One solution for this would be the production and distribution of a CD-ROM for the students with all the course material beforehand.

To evaluate the use of the audio annotations in the lecture "Softwareergonomie" we chose to interview the students after their colloquium. Unfortunately on writing this paper the evaluation still is in progress. For more information see (Grimm 1999). Nevertheless we have first results:

- The majority of the students used the CD we produced after the semester. Nobody listened to an annotation during the course period.
- To improve the usability we need to cut the lectures into smaller pieces than our maximum of 10 minutes and increase the audio quality.
- It seems the annotations are of great interest in the preparation for the exams.
- The students reviewed most of the slides, but they only listened to a small part of the audio annotations, mostly those in connection with graphics, diagrams and summaries.

Prospect

Despite the problems we had to face and will encounter in the future, this approach of enhancing course materials by audio recordings of the lecturer is promising. The process of creating these materials is easy and readily transferable to other courses and different lecture situations. It remains to be seen if the experiences described above are correlated to the form, content, and niveau of the lecture, the lecturer herself, or if they are specific to learning with audio annotations. Therefor we intend to record lectures in other disciplines such as e.g. business management.

Future work will also concern enhancements in quality and size of the materials as well as further functionality. This being especially solutions to questions like what about links *"inside"* the audio-files, or links and references from within documents to just parts of an audio annotation.

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For more information on MPEG Layer 3 see http://www.iis.fhg.de/amm/techinf/layer3/index.html

Video Conference and Distance Learning Scheduling System on WEB

Qinghui (Gretchen) Guo
Northwestern University
2129 North Campus Drive
Evanston IL 60091 USA
Gretchen-guo@nwu.edu

Using the advanced WEB and the Oracle Database technology, I created an interactive videoconference and distance learning management system. This system has been used for 3 years, and has saved a lot time and trouble for both the users and administrators of the videoconference rooms.

Powerful Features

1. Provides searchable and automatically updated Video Conference Schedule on the WEB

A user can view the up-to-date schedule on the WEB, and can search the schedule by date and by the conference organizer's name.

2. Enables users to make video conferencing reservations on the WEB

A user can send a request to reserve the video conference facility by filling out a form on the WEB. The inputted data will automatically be put into a database and a copy provided to the videoconference room administrator via e-mail. Remote site technical information is also inputted this way.

3. Generates Video Conference Room Usage Report

An additional feature generates useful reports to answer the questions such as who had videoconferences, how many times, and with what sites the conferences were held. This feature also provides information such as how many were classes, administrative meetings, or training workshops. It can provide reports on all the videoconferences or for a specified time period. For example, it can answer a question such as how many training workshops have been held from September 1 till December 31, 1998.

4. Complies the form of "Request for Off-NSHEC Network Calling Assistance"

To do an "off-net" videoconference, we need to send a special request form to a company called Tendberg. In the request form, we need to provide both the technical and contact information related to our sites and to the site with which we will hold the conference. The system can compile such forms automatically by pulling data from local user input and from the remote site administrator's input.

An Inside Look

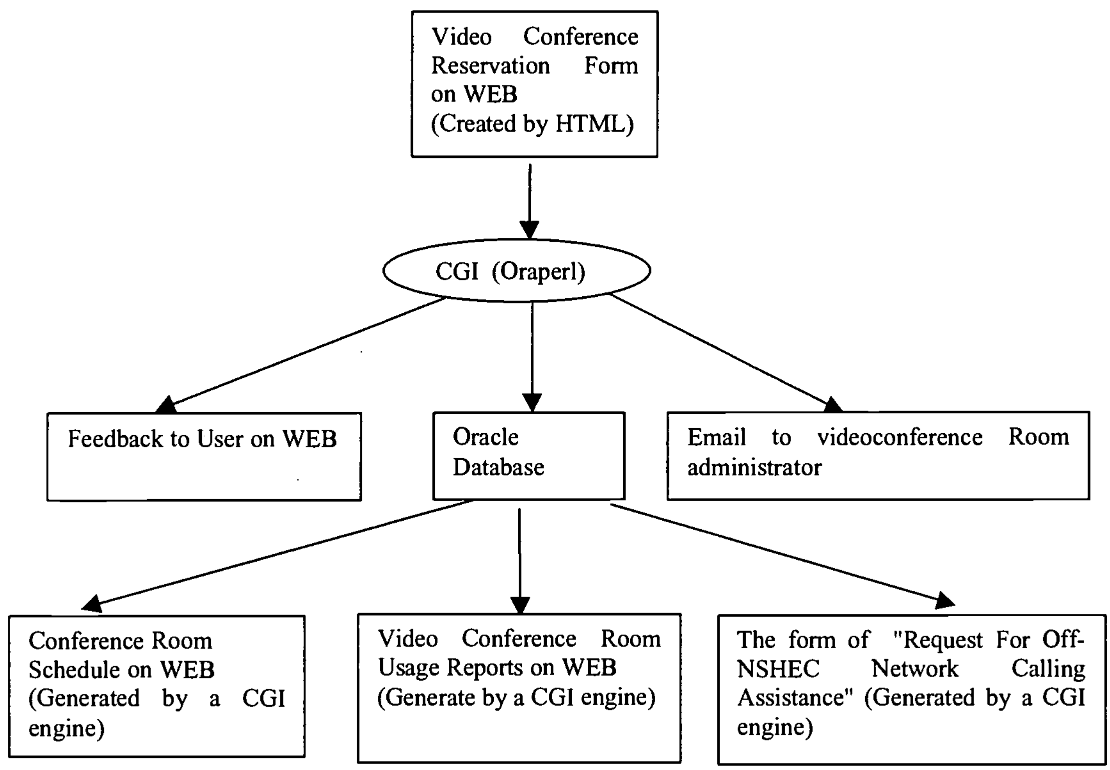
The system was created using WWW, CGI, and Oracle database technology. A user first looks at the videoconference schedule on the web to see if the time they want is available. Then, the user inputs the data about a conference (such as when, where, purpose, and contact person's name, email and phone) by using a reservation form on the WEB. After the web form receives the data, it automatically forwards the data to a

CGI engine. This CGI engine then does three things with the data: 1) generates a web page that sends confirmation and gives further instructions to the user, 2) generates email to send data to the videoconference room administrator, 3) puts the data into an Oracle database. (See attached diagram below)

When the users click on the link to the videoconference schedule on the web, the system sends a request to a CGI engine. This engine pulls the data from the database accordingly, and generates the schedule for the user. In this way, the schedule presented to the users is always up-to-date and tailored toward users' specific interest (See attached diagram).

To generate videoconference room usage reports, an administrator clicks corresponding buttons on the web, which sends a request to the CGI engine. This engine summarizes the data from the database and shows the results on the WEB. In a similar way, the system generates the form of "Request for Off-NSHEC Network

Diagram



"I Made You Look, You Dirty Crook, You Stole Your Mother's Pocketbook!" How To Surprise Your Students With the Opportunity To Learn.

Alfred Benney
Fairfield University
Fairfield CT 06430-5195
Benney@fair1.fairfield.edu

Introduction

Remember when you were a kid how the above taunt reflected youthful humor when you caught someone by surprise? Remember when you took great delight in such antics as "Your shoe's untied!" "Ha, ha, I made you look! April fool!" Or how with two or three of your friends you stood somewhere in public all gazing up at some imaginary thing-in-the-sky and laughed like crazy when passers-by would stop and try to see what you were looking at? Imagine my surprise after many years in the classroom suddenly to arrive at the conclusion that teaching is a lot like that! And to realize that with all its complexity, the real trick to teaching is getting students to really look at something.

My beginning point is the realization that in order to learn, a person must perceive the data as something new -- really to have a new "perception of." Humans tend to see what they expect to see and just looking is in itself boring -- unless we are surprised by what we see! Moreover, our system of education seems to foster the notion that study is boring because it creates the assumption that we won't be surprised. In some way we seem to have mistakenly defined classroom orderliness as quiet inactivity and classroom attentiveness to be a sort of dopey reticence.

The Problem

In an effort to "bring education into the twenty-first century," many educators have adopted without question the assumptions of industry managers who are not themselves educators.

> Walk the aisles of any training trade show and you'd think high-tech America had finally found the magic bullet that would solve the nation's educational crisis. If you can cram a course down an electronic pipe, and deliver it to the desktops of your employees, . . . well, that must be great teaching, right?
>
> Wrong. Corporate America has finally awakened to the need to teach employees how to do not just today's jobs, but the ones they'll inevitably wind up with tomorrow. Demand creates supply – bringing multimedia curricula out of the proverbial woodwork. But do these training programs teach? Today, most don't. And they won't, without sound instructional design – design that engages the student, simulates complex problems, helps her practice, guides her to learn through failure, and – depending upon your point of [1]

If we look upon applications of technology in education as oriented towards "a learning 'with'" model[2], and if we can use this "learning 'with'" model to interrupt student expectations about learning; and if this "interruption" gets their attention so that they really look at the data, the possibility of turning information into knowledge becomes significantly more real.

[1] Fryer, Bronwyn, "Powerhouses of Design," *Inside Technology Training*, April, 1998, p.25.
[2] Reeves, Thomas C., Answering Critics of Media and Technology in Education, *Proceedings of ED-MEDIA/ED-TELECOM 98* (Freiburg, Germany, June 20-25, 1998) pp. 1182-1183.

> Without [effective instructional design] . . . , the most sophisticated "training" in the world is simply information. And information, as M. David Merrill says, "is not instruction." And that's true whether you're sending a program down an electronic pipe or presenting it at the front of a classroom.[3]

The *Status Quo?*

If we define "culture" as simply "the way we do things around here,"[5] the objective would be to use multimedia presentations to interrupt the "business-as-usual" culture of today's student thereby facilitating their involvement in classroom rituals engaging them in the process of education rather than the task of gathering information.

> "It is not multimedia resources that make a difference in training, it is how they are used." Media is merely a way of representing subject matter content. Merely having multimedia objects included does not determine instructional effectiveness. If the media objects are relevant to the instruction, if they facilitate in implementing effective instructional strategies, then the effect is efficient, effective and appealing instruction. If, on the other hand, the media objects are merely decorative and serve no instructional purpose, then they may in fact interfere with, rather than facilitate, learning.[4]

Using technology to manipulate the "rituals" of the classroom could challenge the way students perceive their roles in the classroom and change the understanding they have about learning. Along with this new curiosity, students would discover that they have the ability to change information into knowledge – and can do so with greater flexibility, more efficiency and less pain!

The Strategies

This paper presents examples of nine strategic uses of technology that are effective in teaching an introductory course in Religious Studies. By using varied combinations of these strategies, student expectations about classroom performance are "interrupted" in such a way that the subject matter of each class session is perceived as in some way new. These strategies would be useful in any Humanities class and constitute what I would call "appropriate use of technology." They are (in no particular order):

1) Visuals and animations used to present a graphic definition of the problem or problems, which are the focus of each particular class.
2) A "language resource pool" – a database of questions and/or definitions of terms and complex ideas which are easily accessible in class to stimulate conversation.
Computer programming that maps the interrelationship of ideas and/or that connects layers of thought or information. Part of the problem with humanities courses is that it is often necessary to explain complex experiential events and to connect them with facts or hard data.
4) Animated presentations used to illustrate the development of a logical argument or an historical outline.
5) Interactive programming that challenges student assumptions; this strategy makes student responses public so that they can be perceived as being part of the problem.
6) "What ifs" -- show various hypotheses to stimulate debate about the value of different solutions to a problem – "there are no answers to questions, just hypotheses that suggest solutions to problems that need to be defined."
7) The display of obvious bits of data in ways (relationships) that may not be obvious (lateral thinking) – seeing the obvious juxtaposed in creative ways can create new questions.
8) Digital Video used to create conflict by having a teacher talk with a virtual self or argue a case with another.
9) Digital Video presenting short clips of "experts"/and or scholars commenting on a question or problem and used to illustrate different/contradictory points of view.

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[4] Merrill, M. David, "Instructional Strategies That Teach," *CBT Solutions,* Nov/Dec 1997, p.2.

Distance Learners use of the Internet and Academic Libraries: Supplement or Replacement?

John Barnard
Library Instruction, Systems and Technology
Arizona State University
johnb@asu.edu

During the 1990's the Internet has evolved from primarily an electronic mail system for academics and the military to become the avenue of access for millions of databases worldwide. Web access to massive amounts of information once available only in libraries has impacted library use by adult learners. One sub-group of adults students. distance learners, have long been an underserved academic library population and have the potential to benefit greatly from the resources now available to anyone with web access. The proliferation of learning resources is now making it possible for many students be come at least partial distance learners with some classes and resources being accessed through alternative communications media. These changes are evidenced in the fact that the term "distance learning" is now often replaced with "distributed learning"

In 1998, in an attempt to gain some insight into these changes, I developed a survey that was sent out by the Library, Instruction, Systems and Technology department at Arizona State University. Surveys were sent to 800 students registered through ASU's College of Extended Education. These students had all registered to take classes via television, correspondence, CD-ROM, the Internet or at remote sites. One hundred thirty nine surveys were returned.

My goal was threefold: gather demographic information to tell us who these distance learners are; find out what library services they use and need; and learn how they use the Internet for their information needs.

The median age of the respondents was 32 with an age range extending from 18 to 53. Fifty-six percent were undergraduate and 66% were female. Fifty-two percent were fully employed, while 33% worked part time and 15%were not employed.

A wide variety of majors were represented with the largest group coming from Education with 30%, followed by Public Programs (17%), Social Work (15%), Business (11%), Engineering (10%) and Liberal Arts (9%). Five percent declared no major and Architecture, Fine Arts & Nursing were each represented by 1% of the respondents.

The respondents lived an average of 39 miles from an academic library and 10 miles from a public library. Eighty-five percent of them have Internet access, with 74% of them using e-mail and 67% having used online searches for course related information. In the area of library services 65% have used library web pages, 22% have used interlibrary loan and 14% have used document delivery services

The Internet has become the first information source of choice for 32% of the respondents followed by Academic Libraries (25%), Friend, Spouse, Colleague (16%), Public Library (13%) and Home Reference Books (8%).

While the Internet has become a significant resource for most these adult learners, with 81% agreeing that it is an important source of information to them, libraries are obviously still critical to them with 87% agreeing on there need for library services.

Sixty-seven percent agree that a 1 to 2 hour class on Internet search techniques would be valuable to them. Indicating that, although the vast majority of them use the Internet to some extent, most of them also feel they need to learn more about using it for information.

After the survey, interviews were conducted with 31 local community college students. This group was selected for three reasons: they were generally younger than the surveyed group; they had less need for scholarly information sources; and they were potential ASU students. A few rarely used the Internet but most of them felt that it was the easiest way to find the information that they were looking for. One quote from these interviews is typical of the viewpoint of many of these younger students:

> *I used to always go to the library to look up things in the encyclopedias but now, on-line service is too convenient. I stay at home and use the library. I can access any of the periodicals I want, just about and magazines—I can find back-issues I want on-line. The Internet has pretty much eliminated my library use.*

Conclusion

Searching the Internet has become the first means of finding new information for nearly one third of the adult learners in this survey, ahead of both academic and public libraries. The students still express a strong need for libraries. It is becoming clear that, with more and more information inundating students, the Internet, at least at this point, is mostly a supplement to libraries and not a replacement for them. Younger students with simpler academic needs, however, are often using the Internet as a library replacement.

The importance of resources available through most academic library web sites is the value added to the information by the librarians: the fact that the electronic resources have been selected specifically for academia and are reliable and appropriate sources of information for students. Anyone who has spent any time searching for information on the Web is well aware of the massive amount of information available and also just as aware how unreliable much of it is. Libraries can, any many are, providing network gateways to appropriate academic information resources, including links to many full text journal and news sources, that guide students to the material they need from either a library workstation or a personal computer at home.

The words of one librarian I interviewed illustrate the impact that the Internet has had on academic library use and the raised expectations it has created:

> *They (students) tend to think everything is on the Internet. They tend to think that everything is available the way they want it. They tend to think everything is cost-free... You will find that a lot of times people will come up to the reference desk and the first thing they will say to us is 'I looked on the Internet' and we are not sure they actually did, we are not sure they know what the Internet is, actually. They tend to want that more and more.*
>
> *There is a lot of information out there and it's a lot easier to get to and I think it's more confusing because there is so much -- it's like this overload of information and an overload of ways to find it. We're witnessing that just being at the reference desk with hundreds of databases and the scores of ways of looking for things....Some students are expecting instantaneous packaged information, quickly. They expect that they are going to be able to find this quickly without any problems, so they won't have to stay in the library, or they won't even have to come to the library."*

HYPERMEDIA AND STUDENTS' ACHIEVEMENT: A META-ANALYSIS

Yuen-kuang Cliff Liao
Department of Elementary Education
National Hsinchu Teachers College, Taiwan, Taiwan
Yliao@cc.nhctc.edu.tw

In spite of claims regarding the potential benefits of using hypermedia in education, and the controversial issues about the relationship between media and learning, research results comparing the effects of hypermedia and non-hypermedia instruction are conflicting. For example, Bain, Houghton, Sah, & Carroll (1992), Barnes (1994), Chen (1993), Delclos, & Hartman (1993), Gretes, & Green (1994), and Toro (1995) all report significant gains for hypermedia over non-hypermedia instruction. On the other side, Azevedo, Shaw, & Bret (1995), Barker (1988), D'lessandro, Galvin, Erkonen, Albanese, Michaelsen, Huntley, and Tabar (1991) have found no significant differences between hypermedia and non-hypermedia instruction. Yet, owing to the contradictory evidence provided by existing research in the area, it is important to conduct a meta-analysis to clarify the research conclusions. The results of this meta-analysis may also shed light on the debatable issue regarding the relationship between media and learning.

PROCEDURES

The research method used in this study is the meta-analytic approach which was similar to that described by Glass, McGaw, & Smith (1981). The studies considered for use in this meta-analysis came from three major sources and were published from 1986 to 1998. One large group of studies came from computer searches of Education Resources Information Center (ERIC). A second group of studies came from Comprehensive Dissertation Abstracts. A third group of studies was retrieved by branching from bibliographies in the documents located through review and computer searches. Forty-seven studies were located through these search procedures; 14 studies came from ERIC, 26 studies were retrieved from published journals, and 7 studies were from Comprehensive Dissertation Abstracts. However, one study reported by Liu, & Reed (1995) had an Effect Size (ES) several times higher than mean ES of other studies included in the synthesis (i.e., ES = 6.54 for Liu, & Reed's study). The study was therefore considered as outlier and excluded from this meta-analysis.

Several criteria were established for inclusion of studies in the present analysis.

1. Studies had to compare the effects of hypermedia (HI) vs. non-hypermedia instruction (NHI) on student's achievement.
2. Studies had to take place in actual educational settings. There was no restriction on grade level.
3. Studies had to provide quantitative results from both hypermedia and traditional classes.
4. Studies had to be retrievable from university or college libraries by interlibrary loan or from ERIC, Dissertation Abstracts International, or University Microfiche International.
5. Studies were published between 1986 and 1998.

Outcome Measures

The instructional outcome measured most often in the 46 studies was student learning, as indicated on standard or researcher-develop achievement tests at the end of the program of instruction. For statistical analysis, outcomes from a variety of different studies with a variety of different instruments had to be expressed on a common scale. The transformation used for this purpose was the one recommended by Glass et al. (1981) and modified by others (e.g., Hunter, Schmidt, and Jackson, 1982). To reduce measurements to a common scale, each outcome was coded as an Effect Size (ES), defined as the difference between the mean scores of two groups divided by the pooled standard deviation of two groups. For those studies that did not report means and standard deviations, F values, t values, or proportion values were used to estimate the ES.

Variables Studied

Sixteen variables (type of publication, year of publication , subject area, grade level , sample size, instructor bias, instrumentation, reliability of measure, statistical power, statistics, type of research design, type of delivery system, comparison group, type of instruction for treatment, implementation of innovation, duration of treatment were coded for each study in the present synthesis. Each variable was employed as a factor in an analysis of variance (ANOVA) to investigate whether there were significant differences within each variable on the ES.

RESULTS

Of the 46 studies included in the present synthesis, 28 (61%)of the study-weighted ESs were positive and favored the HI group, while 17 (37%) of them were negative and favored the NHI group. Only 1 (2%) of them showed no difference between HI and NHI groups. The range of the study-weighted ESs was from -0.91 to 3.13. The overall grand mean for all 46 study-weighted ESs was 0.41. When this mean ES was converted to percentiles, the percentiles on students' achievement were 66 for the HI group and 50 for the NHI group. The overall grand median for all 46 study-weighted ESs was 0.15, suggesting that percentiles on students' achievement were 56 for the HI group and 50 for the TI group. The standard deviation of 0.87 reflects the great variability of ESs across studies.

For ANOVA, four variables, instrumentation, type of research design, type of delivery system, and comparison group showed statistically significant impact. For each of these variables, a post hoc (Fisher Protected LSD) test was performed.

The post hoc test for instrumentation, ($F(2,43) = 3.241$, $P<.05$), showed that the mean comparison of studies in which the instrumentation was coded as unspecified was higher than the studies employed local or standardized instruments. There were no significant differences found between the mean comparison of studies using local instruments and standardized instruments.

The post hoc test for type of research design, ($F(3,42) = 6.998$, $p<.001$), showed that the mean comparison of studies coded as one group repeated measure was significantly higher than studies coded as pretest-posttest control group, nonequivalent control group, or posttest-only control group designs. There were no significant differences found among the mean comparison of studies coded as pretest-posttest control group, nonequivalent control group, and posttest-only control group designs.

For type of delivery system, ($F(2, 43) = 3.951$, $p<.05$), the post hoc test showed that the mean comparison of studies in which simulators were employed was significantly higher than studies in which interactive multimedia were employed as delivery systems. There were no significant differences found between the mean comparison of studies in which computer-based interactive videodisc and interactive multimedia were used. In addition, no significant differences were found between the mean comparison of studies in which simulators and computer-based interactive videodisc were employed.

Finally, the post hoc test for comparison group, ($F(5, 48) =4.876$, $p<.01$), showed that the mean comparison of studies with no comparison group (i.e., one group repeated measure) was significantly higher than studies in which the comparison groups using traditional instruction, CAI, textbooks only, or other types of instruction (e.g., audiotapes). In addition, the mean comparison of studies in which the comparison group using videotapes was significantly higher than the studies in which the comparison groups using CAI.

CONCLUSION

The results from this study suggest that the effects of using hypermedia in instruction are positive over non-hypermedia instruction as a whole, however, the effects may be varied depends on what type of instruction that hypermedia compares to. The results of this study also provide some evidences which disagree with Clark's viewpoint about the relationship between media and learning. While many educators devote tremendous efforts with great expectation that technology will dramatically increase students* academic achievement, the results of this study provide to classroom teachers an accumulated research-based evidence for using technology in instruction. Left unanswered is the question of what factors truly affect the diverse outcomes for different types of instructions. Studies of this question will require further clarification of the distinct attributes between hypermedia and various types of instructions, and their relationships with learning. This meta-analysis points out only that improvements of students* academic achievement are possible. That information by itself is useful.

GENDER DIFFERENCES ON ATTITUDES TOWARD COMPUTERS: A META-ANALYSIS

Yuen-kuang Cliff Liao
Department of Elementary Education
National Hsinchu Teachers College, Taiwan, Taiwan
Yliao@cc.nhctc.edu.tw

Although many studies have been conducted on the hypothesis that women and girls are more likely to hold more negative attitudes toward computers. (Blumer, 1987; Campbell, 1988; 1989; Chen, 1986; Koohang, 1989; Loyd & Gressard, 1986; Meier, 1988; Wallace & Sinclair, 1995; Woodrow, 1994), the results of existing studies have reported a confusing picture. For example, Campbell (1990), Chen (1986), Colley, Gale, & Harris (1994), Jacobson (1991), Loyd & Gressard (1986), and Woodrow (1994) all reported significantly higher computer attitudes for males than females, while Blumer (1987), Campbell (1986;1989), Cantrell (1995), Chu & Spires (1991), Francis (1994), Koohang (1987;1989), Loyd & Gressard (1985), and Robertson, Calder, & Jones (1995) have indicated that there is little, if any, differences of computer attitudes between males and females. Owing to the mixed evidence provided by existing research in the area, this study attempts to use the meta-analytic approach to investigate the gender differences on attitudes toward computers. The results from this meta-analysis will help provide clearer conclusion.

PROCEDURES

The research method used in this study is the meta-analytic approach which was similar to that described by Glass, McGaw, & Smith (1981). The studies considered for use in this meta-analysis came from three major sources and were published from 1984 to 1997. One large group of studies came from computer searches of Education Resources Information Center (ERIC). A second group of studies came from Comprehensive Dissertation Abstracts. A third group of studies was retrieved by branching from bibliographies in the documents located through review and computer searches. One hundred and six studies were located through these search procedures; 19 studies came from ERIC and conference proceedings, 80 studies were retrieved from published journals, 7 studies were from Comprehensive Dissertation Abstracts..

Several criteria were established for inclusion of studies in the present analysis.

1. Studies had to assess the differences between males and females on computer attitudes.
2. Studies had to provide quantitative results from both male and female subjects.
3. Studies had to be retrievable from university or college libraries by interlibrary loan or from ERIC, Dissertation Abstracts International, or University Microfiche International.

Outcome Measures

The outcome measured most often in the selected studies was survey data from participants, as indicated in various instruments for examining participants' computer attitudes. For statistical analysis, outcomes from a variety of different studies with a variety of different instruments had to be expressed on a common scale. The transformation used for this purpose is the one recommended by Glass et al. (1981). To reduce measurements to a common scale, Glass and his colleagues coded each outcome as an Effect Size (ES), defined as the difference between the mean scores of two groups divided by the standard deviation of the control group. For those studies that did not report means and standard deviations, F, or t, values were used for estimating the ES.

Variables Studied

Nine variables were selected for coding each study in the present synthesis. The first 2 variables (nation of Subject, population Group) were coded so that potential different effects for subjects with different background could be detected. The following 2 variables (i.e., type of publication and year of publication) were coded because it is important to know how effects are related to sources of information over time. The next 4 variables (sample Size, reliability of measure, statistical power, and statistics) were coded so that effects related to characteristics of research design could be detected. The last variable (type of Attitude) was coded because it is critical to know how effects are associated with different types of attitudes. Each variable was employed as a factor in an analysis of variance (ANOVA) to investigate whether there were significant differences within each variable on the effect size.

RESULTS

Of the 106 studies included in the present synthesis, 85 or 80% of the study-weighted ESs were positive and favored the male subjects, while 21 or 20% of them were negative and favored the female subjects, indicating that males had lower computer anxiety than females. The range of the study-weighted ESs was from -0.85 to 0.881. The overall grand mean for all 106 study-weighted ESs was 0.192. When this mean ES was converted to percentiles, the percentiles on computer attitudes were 58 for the male subjects and 50 for the female subjects. The standard deviation of 0.286 reflects the small variability of ESs across studies.

Among the 489 ESs included in the present synthesis, 363 or 74% were positive and favored the male subjects, while 121 or 25% were negative and favored the female subjects. Only 1 or 1% of the ESs indicated no difference between male and female subjects. The range of the ESs was from -0.85 to 0.881.

The positive means for liking, belief/usefulness, confidence, and mixed indicate more positive attitudes favor male subjects; however, for sex stereotype and ability stereotype, the positive means indicate a higher sex and ability stereotype for male subjects.

For ANOVA, 1 variable, type of attitude, showed statistically significant impact. The post hoc test for type of attitude, ($F(6,232) = 2.554$, $P<.05$), showed that the mean comparison of studies that measured sex stereotype was significantly higher than studies that measured liking, anxiety, belief/usefulness, confidence, ability stereotype and mixed attitudes. In addition, the mean comparison of studies that measured belief was significantly higher than studies that measured mixed attitudes.

DISCUSSION

The results of this meta-analysis indicate that, overall, male subjects had slightly higher computer attitudes than female subjects. An effect is said to be small when ES = 0.2, medium when ES = 0.5 and large when ES = 0.8 (Cohen, 1977). Eighty percent of positive study-weighted ES values and 74% of positive ESs overall also confirm the gender differences on computer attitudes. The slightness of the differences must be keep in mind, however; the overall study-weighted mean ES of 0.192 only indicates 8 percentile scores higher than the female subjects. The percentile scores for the overall grand mean and median were identical, reflecting the small variability of ESs across studies.

The significant differences found among the mean comparison of studies that measured sex stereotype and studies that measured liking, anxiety, belief/usefulness, confidence, ability stereotype and mixed attitudes were quite interesting. It is possible because male subjects hold higher sex-related stereotype toward computer use, and this tendency influences female subjects' feelings about computers that results in females' overall more negative attitudes toward computers. In short, the gender differences on sex-related stereotype toward computer use may be the key factor that yields the gender differences on overall attitudes toward computers. More studies need to be addressed on this hypothesis.

CONCLUSION

Although many studies have been conducted to examine the hypothesis that women and girls are more likely to hold more negative attitudes toward computers (Blumer, 1987; Campbell, 1988; 1989; Chen, 1986; Koohang, 1989; Loyd & Gressard, 1986; Meier, 1988; Wallace & Sinclair, 1995; Woodrow, 1994), and still fail to get a clearer picture, the results of this study provide an accumulated research-based evidence to support this hypothesis. Left unanswered is the question of what factors truly contribute to the differences. Studies of this question will require further clarification of the exact characteristics of each type of computer attitude (e.g., anxiety, confidence, and sex-related stereotype) and their relationships with gender. This meta-analysis points out only that gender differences on attitudes toward computers exist. That information by itself is useful.

A Monitoring Program for Evaluation of Educational Software on the World Wide Web

Edna Ruckhaus
Department of Computer & Information Science
Universidad Simón Bolívar
Venezuela
edna@sa.omnes.net

Introduction

The evaluation of educational software can be divided into two phases: 1.- the formative evaluation which is done during software design and development, its aim is to determine the capability of the software to satisfy user learning needs, and 2.- the summative evaluation which is done once the software is implemented, its purpose is to relate the context of usage to learning effectiveness. In both phases, educators and software developers have relied on traditional methods of evaluation like interviews, direct observation, pre-tests and post-tests. During the past few years, the number of educational applications that is published on the World Wide Web has increased considerably, meaning that we can no more evaluatethe usage of software in a controlled environment.

The purpose of this project is the development of a monitoring program that automatically generates information that is useful for carrying out summative evaluation on educational software that is used on the World Wide Web. The program collects data (measures) on a group of variables, several of the results are expressed in terms of fixed parameters that represent the logical or recommended student performance. The monitoring program stores the measures in a database: raw data can be consulted, and statistics are produced on demand. In this way, the results are available for analysis and evaluation.

Experts in design and usage of educational software introduce the parameters. The final comparison and analysis should be done by experts in content, usage, and educational techniques, technical and graphical experts, and language communication experts. An important part of the project has been the development o a framework for analysis that relates measures to software characteristics: these include flexibility, legibility, consistency, grammatical correctness, interface, content, degree of interaction, browsing capabilities, media resources and technical features. For each characteristic there is a set of indicators of possible software flaws.

The implementation of variables has been done for a prototype tutorial course on Local Area Networks that is representative of a hybrid educational application (tutorial & drill). The course was developed in *HTML*. The Variables Database was developed in the *Informix* DBMS. The monitoring program includes code in both *JavaScript* and *Informix 4GL CGI (Common Gateway Interface)*. The next research phase will be the analysis of data collected by the monitoring program during its usage by a group of Systems Engineering Students. Simultaneously, data will be collected and analyzed through more traditional methods. By comparing both analysis, the monitoring program will be validated.

Use of hypermedia in educational applications

Multimedia becomes *Hypermedia* when the designer provides a structure of elements through which the user can browse interactively according to his interests (Vaughan 94).

The prefix "Hyper" refers to the methods for non-sequential browsing through an information content. The suffix "Media" is related to the availability of the information in different forms such as audio, video, graphics, animation and text. Two terms are considered fundamental in hypermedia systems: *link* and *node*. A *link* is a connection between conceptual elements, and a *node* contains text, graphics, sounds or any information related to the knowledge base.

The hypermedia concept has allowed to question the manner in which information is structured to produce learning (Rivard 95). Traditional instruction intend to create links between student's previous knowledge and new knowledge. These links are created step by step, in a manner that is conceptually sequential. *Hypermedia* structures information in a non sequential manner through associative links, causing individualized knowledge acquisition and manipulation.

Links are the navigation "guides". Navigation tends to become more complicated when an associative link connects to a node that has several associative links as well. The evaluation of Hypermedia educational applications should take into account the usage of media resources and the navigation path followed.

Monitoring Program

The variables established for the evaluation of educational software were determined from the inherent characteristics of an hypermedia educational software. Each variable takes values as a result of the measurement of student performance during software use.

The monitoring program takes the measures of each variable and stores them in a database. The interaction with the database was developed with the *Informix CGI Library* which extends *Informix 4GL* capabilities for the development of Web applications.Two different approaches were followed for programming the measures taken by the monitoring program:

- Directly in the *HTML* page belonging to the educational software, using a routine written in *Javascript*, and then stored in the database using *CGIs*.
- In the *CGIs* themselves

The measures are the following:

- Navigation Path: These are stored in the database as a string consisting of the names of the pages visited separated by a special character. The page name is brought from the page to the *CGI*.
- Time: The moment the browser loads the HTML page belonging to the educational software the time is stored and then, when the student leaves the page, the *CGI* script is called and the difference between both times is calculated.
- Questions & Answers: The answer is evaluated by the educational software, and then sent to the *CGI*.
- Ending: These measures are determined in the *HTML* page using a variable that indicates if it is the last page of the section.

Some of the measures are calculated using data already stored in the database. For example, the number of correct and incorrect answers, number of times a content or help page is visited, number of times an audio or video resource is invoked, and total execution time of the application.

The parameters establish standards or a value range for each of the variables against which the results can be analyzed and measured. A few of the parameters are the following:

- Recommended navigation path
- Estimated total time for each section
- Number of times a resource should be invoked
- Number of times the Help section should be visited
- Recommended execution time of each session

For instance, for the variable Navigation Path some of the results are the following:
R1. The navigation path is the same as the recommended navigation path.
R2. The navigation path is different form the recommended navigation path.
R3. The student visits several times the same section.
R4. The student did not visit a certain section.

The result R1 is related to the characteristics Flexibility and Sequence. Flexibility is the degree in which the software permits the student to work at his own pace or according to his interests, and Sequence has to do with structure, location indicators, ability to stop and resume in the same place, and exit options. These characteristics could lead to possible software flaws.

Conclusions

The design and development of educational software has been an important research area in many universities, specially in those that offer Distance Education; however, computerized evaluation has been an area little explored. The monitoring program described in this paper is the first phase of a project that is aimed to achieve evaluation in a context where other evaluation methods are not available.

The monitoring program not only allows evaluation by the design and usage experts that are related directly with a certain educational software, but also by any professor that uses the World Wide Web as a means of instruction for his Distance Education Students.

It should be noted that the time parameters can be affected by the variability of connection rates due to factors like the telephone network, the Internet service provider, and the Web Server demand.

It is recommended that pilot tests be done with the purpose of determining the parameters needed for further analysis and evaluation.

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A CONCURRENT MICROWORLD

Giuseppina Capretti, Antonio Cisternino, Maria Rita Laganà, Laura Ricci

Dipartimento di Informatica,
Corso Italia, 40
56100 Pisa Italy
Phone +39 50 887111
Fax +39 50 887226
e-mail {capretti, cisterni, lagana, ricci}@di.unipi.it

The Logo language (Harvey, B., 1997) has been ideal for students first approach to computer science: today the evolution of systems and programming languages has caused the evolution of its implementations including multimedia, graphics and concurrency features (Cisternino. et at., 1998) (Resnick 1990).

In this paper we propose a micro-world based on the Logo programming philosophy: the user may program interacting entities through a language that integrates the Logo turtles primitives with constructs to co-ordinate and synchronise concurrent agents. The power of this system is allowing a decentralised way of modelling the world: a creature has "conscience" of itself and interacts with the surrounding environment in explicit way using communication primitives. This approach is different, for instance, from that of the StarLogo system (Resnick 1990) where a turtle is view as part of a community.

The system we present, is an evolution of the Orespics system (Capretti. et al., 1998), an environment in which students guide the action of virtual robots through the Logo- PL language. The environment includes a friendly graphical interface by which students can use Orespics as a game. The language is provided with traditionally sequential constructs, constructs to control the concurrency and communication primitives (Hoare, 1978). In our experimentation, we have noted that this set of concurrent constructs is not sufficient to solve all problems that students fantasy suggests them. We have extended Orespics system to define the "Advanced Orespics" environment, a new system including non-deterministic features and other forms of communication; furthermore the students may define "creatures" appearance. This new type of interaction among creatures allows exploring the world in a decentralised way: a child has to modify his/her way of thinking according to this paradigm.

We present the spirit of Advanced Orespics through an example: we show how the classical problem of Hanoi towers may be programmed in our system by defining the behaviour of each disk in a decentralised way: each disk has its own identity and may interact with the word autonomously.

The well known Hanoi tower problem is the following: a monk has three pegs and has to move n disks of increasing dimension from a peg to another one with the constraint that a disk may be put on another one if and only if its dimension is smaller. The problem of Hanoi is a typical example of the power of recursion in the classic Logo language. We exploit the same problem to show the power of a decentralised way of thinking. We believe that an agent approach is intuitive for this problem: each disk is an agent that is capable to move from a peg to another peg in respect to the problem constraints. The disk is capable to receive the message "move to peg *x*" and knows the peg where it is located. In order to move from a peg *x* to a peg *y* there are two possibilities: the selected disk D is on top of *x* or not.

If *D* is on the top, we consider two sub-case: if the topmost disk on the destination peg is bigger then it, *D* moves from *X* to *Y* immediately, otherwise *D* asks to the lowest disk smaller than it on the destination peg, to move to the third peg *Z*. If *D* is not on the top, first it asks to the disk above to move to peg *Z* in order to become the topmost disk and then it behaves as describe above.

There is a starting process that tells to each disk starting from the biggest dimension one, that it must reach the goal peg.

This solution consists in creating a different creature for each disk and a monk creature that activates the disk movement: a different process is associated with each creature. We use Orespics PL syntax (Capretti et at. 1999) to write disks and monk programs. The programs are the following:

```
Agent monk
 i <- 1;
 while ( i <= n )
  send&wait C to disk_i;
  wait&receive OK from disk_i;
  i <-i+1;
 endwhile
end

Agent disk_i;
 myPeg <- A;
 myDim <- n-i+1;
 repeat
  wait&receiveAny peg;
  while (dimTop(peg)< myDim or seeUp() <> nil)
   if (seeUp() <> nil )
    receiver <- seeUp();
   else
    receiver <- Max_Of_Smaller(peg, myDim);
   endif
   send&wait third(peg, mypeg) to receiver;
   wait&receive OK from receiver;
  endwhile;
  I_go(peg);

  send&wait OK to Sender(peg);
 until (is_My_Right_Position());
end
```

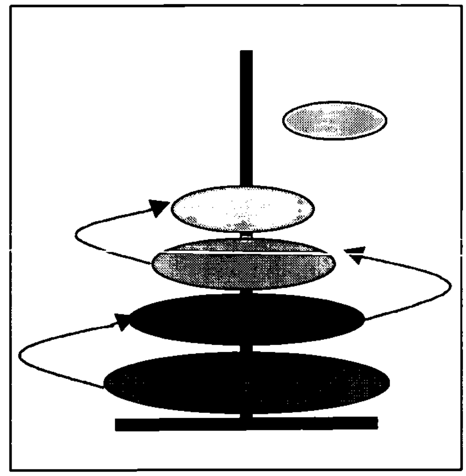

Figure 1: The first movement

where *seeUp*, *dimTop*, *max_Of_Smaller*, *third*, *is_My_Right_Position* and *I_Go* are macros created by the teacher. *seeUp()* returns the identification of the disk located above the disk invoking the function; *dimTop(P)* receives the identification of a peg *P* and returns the dimension of the disk on the *P* top; *Max_Of_Smaller(P, d)* function receives in input the identification of a peg *P* and a dimension d and returns the identification of the first disk on the peg *P* whose dimension is the greater of the smaller than d. The macro *third(x, y)* returns the identification of the peg different from *X*, *Y* pegs and *is_My_Right_Position()* returns true if the disk is in the right order on the peg *C*. The *I_Go(P)* macro manages the movement of the disk from the actual peg to the *P* one and updates the value of the *myPeg* variable with this new value.
We stress the fact that the disks are numbered from 1 to n, from the greatest to the smaller one.
The macro defined may be implemented through Orespics- PL language, for instance the teacher may implement a state manager, storing how the disks are distributed on the pegs. This means that the student is able to learn the laws of the worlds till he gains the skills to program all the problems.
In this program we use the primitives *send&wait* and *wait&receive* allowing a synchronous communication between agents: Orespics system includes a rich set of communications to describe better different real situations. For the first time these features are included in a language for teenagers.
Since the world may be perceived as a set of interacting entities, we think that it may be naturally modelled in our system through agents and communications.

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Evaluating On-line Courses

Ulric Björck
Göteborg University, Department of Education, Göteborg, Sweden
ulric.bjorck@ped.gu.se

Introduction

A broader use of on-line courses has become more widespread in recent years. Virtual universities are popping up almost all over the world and the development towards more on-line education in higher education is continuing (Brown, 1998; Tomlinson-Keasey, 1998). The use of Computer Mediated Communication (CMC) is affecting and changing the society, as we know it. A common opinion and a frequent one in a lot of research is that the computer is simply a tool. We find that the computer indeed is a tool, and a very powerful one, but the computer and especially the use of the computer, is much more than a tool. In fact, the use of computers and especially the Internet is changing some of the fundamentals in the world today and it definitively affects several areas.

Dowling (1998) stresses that the use of CMC should be studied focusing more on the social and relational aspects of our virtual lives since they may very well prove to be important for learning. Research on the development and use of communication conventions in CMC has been going on for quite some years now (Murphy, 1997), but theoretical foundations of evaluating on-line courses have not been given a lot of room in the current research debate. In many cases, transcripts of asynchronous conferencing in instructional environments have been studied (Harasim, 1990; Henri, 1992). Analyzing transcripts has been established as a good way to study communication and cognition in coordination with the ideas within the scientific field of situated cognition. This can be recognized as guidelines and valuable information in evaluating on-line courses since the knowledge built and constructed within these particular frameworks could prove useful to the evaluator. Theories and writings about evaluations in a broader context are quite extensive (Lander, 1987). In this paper I will elaborate the views and writings that have proved to be significant in evaluating on-line courses. The focus will be on the use of formative evaluations.

Formative evaluations

Cronbach (1983) describes the design of an evaluative investigation as an art. There are several decisions to be made and the choices to be made are almost innumerable. The choices that are made will undoubtedly lead to particular advantages and disadvantages. It is therefore important to focus on considerations and choices behind the design of the evaluation. An evaluation plan is constructed to secure that the resources available for the evaluation, and the research, is used in such a way that as much useful and necessary data as possible are collected.

A single definite question is often the starting point of an evaluation, but this has begun to change when it comes to evaluating CMC (Kinzie, 1991; Tessmer, 1994). A single question assumes that the objective of the course has been fixed and that the aim of the evaluation is to assess its merit. Scriven (1967) christened such evaluations summative; to contrast them with the formative study which regards the program as fluid and seeks ways to improve it. The formative evaluation method could be described as a more diagnostic evaluation method than the summative. Cronbach (1983) stresses that in a formative evaluation what variables deserve close attention will be discovered as the fieldwork proceeds which is something that seems to suite the designers and evaluators of today's computer applications. The proper function of evaluation is to speed up the learning process by communicating what might otherwise be overlooked or wrongly perceived. The evaluator, then, is an educator. His success is to be judged by his success in communication; that is, by what he leads others to understand and believe. Payoff comes from the insight that the evaluator's work generates in others (p 8). Scriven claims that the "curriculum builder is almost automatically engaged in formative evaluation, except on a very strict definition of "evaluation". He is presumably doing what he is doing because he judges that the material being presented in the existing curriculum is unsatisfactory" (p 43).

Scriven's writings are particularly interesting today because an additional unsatisfactory part in evaluating on-line courses is the use of the on-line course environment in itself. It is obvious that this environment is not 100% satisfactory and as the unsatisfied evaluator it is therefore important to proceed and construct new solutions. Scriven holds the formative evaluation in favor of a traditional summative approach by the basic fact that the "ordinary" evaluator, while a professional in his own field, is usually not a professional in the field relevant to the curriculum being reformed. Scriven's description is often accurate today when computer scientists and designers are preparing new on-line course environments for students in other courses than their own subject. The meetings between the evaluator and the professional in the field often leads to the exchange of knowledge and a broader perspective on both accounts.

Results

Formative evaluations provide a sound and flexible possibility to evaluate on-line courses. The on-line course environment, which is supported by the Internet, is a continuously changing environment and therefore the formative evaluation method is particularly suitable to meet higher demands on quick changes of the course. An additional aspect supporting the formative evaluation approach is that a lot of on-line courses are not in a regular educational program, they are often done within a particular project environment. If these evaluations were summative, any suggestions of improving the courses would be too late for the current project.

The formative evaluation method has been given a diagnostic function, rather than a function of making final conclusions and standpoints. The curriculum builder is almost automatically engaged in formative evaluation, except on a very strict definition of "evaluation" (Scriven, 1967). The evaluator is presumably doing what he is doing because he judges that the material being presented in the existing curriculum is unsatisfactory. One unsatisfactory part of on-line courses could be said to be the use of the on-line course environment. It is obvious that this environment is not 100% satisfactory and because of this it is important to proceed to construct new solutions. In constructing new solutions and communicating them, meetings with the course management are crucial in succeeding as a formative evaluator.

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A Flexible Workflow Structure for Learningware

Deller James Ferreira
Computer Science Dept.
Federal University of Goiás
Brazil
deller@inf.ufg.br

Hugo Fuks
Carlos José Pereira de Lucena
Computer Science Dept.
Catholic University of Rio de Janeiro
Brazil
aulanet@inf.puc-rio.br

Introduction

A Web-Based Instruction(WBI) approach employs a wide range of instructional strategies using the resources of the World Wide Web (Pernici et al. 1997), (Reeves & Reeves 1997). The Web environment promotes active knowledge acquisition and collaborative learning, allowing students to interact with a variety of information and to communicate with different people. In the process of designing a WBI application, we can explore the fact that instructional design does not have a rigid structure, due to its multiple paths to solutions. Course designers traditionally treat constructs as regular and well-structured, idealizing a best solution presented in a plan of action to be strictly followed by the students. A traditional instructional designer believes that there is a single, best way to conceive knowledge; in other words, there is a single schema or concept that best describes any object or event. That best method is revealed by task analysis. However, in order to comprehend concepts, learners should understand and personally form their own intentions based on different perspectives of content and action. The aim of this work is to provide controlled cognitive flexibility, in which different perspectives are explored and represented in a structure that allows distinct plans of action to be generated. Students should be able to follow their intentions, forming their own plans of action and at the same time be attracted to the expectations and requirements of the course. The students' intentions will be influenced by their instructor and by other students in order to improve performance. Students should have relative freedom of action, but there should be some way whereby it is possible to detect whether they are moving away from the objectives proposed by the course instructor and/or below the performance of the group of students attending the course. It should be possible to assess each student from time to time. If a student has a low grade, the instructor may impose some kind of behavior until the next assessment, by means of restricting the possibilities of creating his/her plan of action. In addition, at any point in the flow of action, a visualization of the information about the group's previous interaction and the different possible future paths of action should suggest the direction to be followed by the student.

Workflow Technology and Learningware

The subjacent technology used to pursue the proposed objectives is Workflow technology (Abbot & Sarin 1994), (Benjamin et al. 1995), (Dourish 1996), (Glance et al. 1996), (Khoshafian et al. 1995), (Miller et al. 1995), (Walters 1995), (Winograd et al. 1992). A Workflow has an infra-structure that facilitates the execution and control of work. A Workflow system automates plans of action, by means of a process model that addresses a sequence of tasks to be rigidly followed by its users. The users' actions are restricted to valid movements predicted in a flow of action. Workflow aids the rationalization and explanation of action, however its flow has to be strictly obeyed. Therefore, students are easily presented with the course objectives, however they are not able to be active in learning. A fundamental point in this work is to adapt Workflow technology to fit an appropriate cognitive flexibility in an educational context. The adapted Workflow structure must maintain advantages and eliminate disadvantages. The focus is to use a clear structure to present the material available and requirements as well as to provide multiple representation of content and different paths of action.

A central point in this work is the elaboration of a flexible Workflow structure related to learningware. The term *learningware* overwhelms the term *courseware*, not only because it is related to active interaction but also because it incorporates group collaboration. Characteristics should be adopted that make communication, coordination, cooperation and contributing to a group synergy feasible. On the whole, there are three complementary and inter-dependent aspects that form the starting point in our general problem solution. The three aspects to be investigated are a flexible Workflow structure, a coordination structure and a visual interface for communication and analysis of plans of action.

Firstly, the Workflow rigidity arises from viewing work processes as unfolding along a single line of temporally chained pre-fixed activities. A flexible Workflow structure should consider the possibilities of modifying a workflow, like changing the action sequence and altering, including, and excluding actions. We intend to work in a Workflow formalization, in which students will have active but predictable behavior; they will have the opportunity to change the action sequence at some pre-determined points in a workflow and to alter some pre-fixed actions. For example, if a causal dependency between two actions exits, there is no way to modify it, on the other hand if a dependency is an instruction suggested it may be followed or changed by the student. Students may alter the action hierarchy, to decide at which level of partonomy or specialization to act. They may navigate through different levels of knowledge taking action and subtracting detailed action or not. Our flexible Workflow approach allows users to control the way in which sequencing operations are carried out and allows some activities not to proceed, but to be recognizable in the system. This maintains a correspondence between user action and process representation. A mediating between the active user interaction and the work representation, rather than the enactment of a process, provides students with an opportunity to enter the work process and also gives students and instructors control over the way the work is organized. Our Workflow structure may be considered mobile, because it incorporates different possible plans of action. By reaching decisions students decide which learning strategy will be used. They have autonomy, independence, strategic initiatives and guidance.

Secondly, a coordination structure has been developed to overcome sources of misunderstanding among learners and to promote advanced knowledge acquisition, avoiding oversimplified behavior. Consider a Workflow instance for each student: suppose a student starts an interaction with the Workflow; at some pre-determined moment during the course an assessment should occur. If a student is not doing well, he/she will receive a new Workflow. This may contain restrictions of flexibility or changes in its structure. With respect to coordination, there is also an agent called Attractor. The Attractor is partially responsible for evaluating a flow context and signalizing it to the interface. We define a flow context as a flow between two different moments in time. Before reaching a decision that implies action, users may ask the Attractor to show the consequences of that decision, in other words, to show different possible future flow contexts as well as a partial evaluation. This evaluation may show, for instance, whether a flow context is oversimplified. Students may also see their previous flow contexts and/or the previous flow contexts of other students. In order to assess learners, instructors require context information from the Attractor. A principal concept is that the Attractor suggests instead of imposes.

Thirdly, there is a visual interface that visually presents the information provided by the Attractor. The interface visually distinguishes between a good or bad flow context. Moreover the interface is also used to present the workflow and to identify which points of its structure could be modified by students. By means of the interface, students are able to visually analyze their future perspectives and to compare their cognitive strategies with those of other students. Alternatively, they may create their plans of action as copies of other students' plans of action or as a combination of various students' plans of action.

Conclusion and Future Work

There are other approaches giving more flexibility to Workflow, but this subject has not been explored very much for educational purposes. There is no Workflow technology that is suitable for every domain. Our work is an attempt to fit this technology into an educational context.

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From the Ivory Tower to Everyday Practice - Action Research and Co-operative Learning in an ICT-supported Learning Environment

Bodil Ask, Dept. of Technology, Høgskolen i Agder, Norway, bodil.ask@hia.no
Harald Haugen, Dept. of Teacher Education, Høgskolen Stord/Haugesund, Norway, harald.haugen@hsh.no

Background for the SULDAL[1] project

A recently established Norwegian 'NetUniversity' (NU) is a formal extension of a 5 years long collaborative project between four Norwegian institutions (universities), offering nearly 100 different ODL courses through Internet to nearly 5000 students every year. An important characteristic of the virtual NU is the mutual exchange and joint development of learning materials, where students can cross institutional borders in their choice of subjects, a flexibility that is of great value also to external students.

The staff at teacher training institutions needs experience from field trials where the different pedagogical ideas and technical solutions are tested in real educational situations. The danger is prevalent that bright ideas and perfect theories are borne and bred in academic isolation, well shielded from practical problems and disturbances. Only in real situations can new ideas prove their true value. ICT invites for new learning situations, changing the traditional 'teaching' into more student active 'learning' environments.

Some local communities are willing to invest considerable funds and up-to-date infrastructures in order to improve their local school systems and facilitate the lifelong learning process of their inhabitants. Suldal, is a scarcely populated municipality with 7 small schools, separated by deep fjords and steep mountains. A central objective of their investment in ICT is to strengthen contact and unity among the population, fostering collaboration and exchange of skills and ideas. The schools are expected to have central roles in this development.

Project methods and design

Project outline

Problem definitions for the research activity concentrate on two main areas:

1) Organisation and infrastructure for integration of ICT in the classroom, in the school and in the total community school system. What are the goals, and will the chosen structure lead to reaching the goals? How do we create an optimal learning environment?
2) Roles of the different actors in the practical work. What changes in roles and activities are observed during the project period? The primary actors are the teachers and students/pupils, but the roles of parents, employers and community are also of interest.

Action research and collaborative learning

Action research is chosen as the main method. It is based on close relations between practice, reflection, and change. The framework is most appropriate for participants who are willing to adopt some initial stance in regard to a problem, formulate a plan, carry out an intervention, evaluate the outcomes and then develop further strategies in an iterative fashion. Action research is by nature cyclical or iterative.

Action research empowers all participants. Involvement is of a knowing nature, with no hidden controls or preemption of direction by the researcher. All participants negotiate meaning in the analysis of the data and contribute to the selection of interventionary strategies. The method implies a situation where informal evaluation will be a continuously ongoing process, bringing about feedback of many kinds. In addition more

[1] SULDAL' = 'SkoleUtvikling, Lærarutdanning og Læringsmiljø'
= school development, teacher training and learning environment

formal evaluation in the form of systematic interviews and questionnaires will take place for groups of relevant actors.

In traditional, curriculum-based learning the learners work individually, without sharing their learning in a public forum, and work largely in isolation. The method of *collaborative learning,* which is focused here, engages the learner in thinking about *why* they are learning, and how the learning may benefit the group. This kind of learning has long been an interesting aspect in pedagogical theory, and is now gaining further interest in relation to new ICT, where the network is a major tool for collaboration (D. McConnell; 1998).

Who is learning from whom in this project? Naturally the students should be learning from their teachers. Equally important, however, is the learning that takes place between students - and between teachers, where they exchange experiences and information and construct their own knowledge through trial and error, by sharing the learning tasks and communicating results in a positive way. Furthermore, teachers will also learn from their students, particularly when it comes to technical skills and new ways of finding information on the web, where the new generation seems to have a much higher adaptability than their parents.

Collaboration among institutions is one of the strategic approaches given prominence in this project. The enormous efforts and resources needed for providing learning material to new groups of learners simply require that parallel work should be avoided. The participating schools will benefit from co-operation, exchange of material and sharing of duties. Internet increases the functionality and facilitates practical activities among co-operating institutions.

Practical approaches

The practical part of the project includes

1. Initiation and motivation, with installations, infrastructure, planning and basic training of all teachers, and starting further training of some interested 'resource teachers'.
2. Integration of ICT into subject matters and methods. The teachers are central actors, with researchers and other resource personnel as partners to help find the most rewarding applications of ICT
3. Making the technology transparent, i.e. working with the learning process in an electronic learning environment, without paying any attention to the ICT itself

Obstacles - and how to overcome them

Major difficulties are the wide variety of backgrounds among teachers involved. Some of them are ICT 'specialists' with a very high motivation, eager to start the activities. Others are more moderate, not too well prepared, but positive to trying new ways and methods in the teaching process. A third group even expressed a negative attitude from the beginning, but gradually seem to be more open and interested in the new possibilities.

Technical difficulties are not yet a story of the past. Despite new PCs, new networks, professional installations and local support, there are still problems. A support team has a vital role, and an on-line helpdesk is available.

Status

- Infrastructure and technical installations are functioning well
- Motivation and involvement of the teachers have increased throughout the period
- A training programme for the teachers has started, differentiated according to interests
- A common web site is available to all actors: http://hugin.hsh.no/lu/inf/suldal2/Suldal.htm
- Each school has provided a report of their activities and intermediate goals
- The web site functions as an evolving resource base for teachers, students and researchers
- Action research is carried out. Academic staff, MEd and PhD students participate in class and school activities, and revised plans and *actions* are made
- Gradual change of guidance and contact from physical visits to netbased communication & exchanges

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A Nontraditional Use of WebCT: Communication Applications in an Educational Mentoring Program.

Sue Elwood-Salinas, M. Ed.
Texas Tech University
Box 41071
Lubbock, Texas 79409-1071 U.S.A.
Email: s.elwood@ttu.edu

Annee Daniel Bayeux, M. Ed.
Texas Tech University
Box 41071
Lubbock, Texas 79409-1071 U.S.A.
Email: adaniel@ttu.edu

Introduction

The purpose of this paper is to describe communication applications within the program *Intercambios*, using an integrated, server side software package called WebCT. *Intercambios: A technology, learning, community service and career awareness program* provides adolescent mentoring from career professionals and university students. WebCT's low learning curve and sophisticated communication features enhance each participant's ability to collaborate in the career mentoring process. This paper will briefly outline the grant's objectives, current projects, and future developments related to WebCT.

The Goal

The primary goal of the grant is to decrease the juvenile crime rate for the junior high school participants. Secondary program goals consist of increased leadership skills, more integrated curriculum projects involving the Internet, greater technology-related field experiences for university students, and exposure to career options by having pupils work with career and academic mentors. Program directors looked for a software program that would help them to achieve these objectives.

The Problem

The *Intercambios* program consists of the junior high pupils and teachers, university students and faculty, and local and world wide career mentors. The program required face-to-face mentoring combined with on-line resources to facilitate communication with career mentors. Since much of the participation involved on-line communication between adolescents and adults, it was vital to find a software application that could provide a monitored and secure communication environment. Another important need of the program and feature of the software was the ability to collaborate on a synchronous and asynchronous level. Email, or some other form of private electronic correspondence, was a highly desirable feature in order to maintain a supportive and confidential relationship between mentor and mentee. Additionally, discussion groups could introduce new careers and mentors to all participants, providing a continual renewal of fresh ideas. Therefore, a password-protected environment including private email, discussion lists, and chats are desired features in the software package.

Several possibilities exist for asynchronous and synchronous communication via the World Wide Web today. The project needed to focus on applications like self-contained email, discussion lists, chat sessions, and collaborative planning tools. Finally, if was imperative to find a single software package with a low learning curve in order to avoid the training and retraining of participants. Our primary challenge is to fulfill the gap created by the needs for *Intercambios* and the current state of innovative educational technologies. We believe WebCT can fulfill this gap.

Current Development

WebCT has been chosen as the innovative technology tool for this project, based upon university reviews of the software in comparison with other related courseware applications. After reviewing three top courseware contenders, Wayne Miller, Manager of the Humanities Computing Facility at UCLA stated, "It became clear to us, though, that WebCT offered by far the best ratio of cost to features [sic] and flexibility among the systems that we considered." Brian Morgan of Marshall University adds the observations that the strongest features of the software are its on-line testing and grading features. These desired features relate to pupils' preparation needs for future *Intercambios* program development. Morgan also noted that Marshall University's top three features sought in such an application were: ease of use, on-line testing and grading, as well as excellent technical support staff.

Although the program has regularly scheduled hours and meeting places, scheduling conflicts due to work and school obligations for all participants are common. As a solution to this conflict in time and space, career mentors establish initial contact via a discussion list or private email to interested pupils. Pupils will then be prepared to interview the career mentor in their choice of conferencing format and time schedule: email, discussion group, or chat sessions. The combination of WebCT's synchronous and asynchronous communication and a closed environment for email will best serve all schedules involved for a safe and optimal career mentoring experience.

The chat rooms, discussion groups, and private email can also be used by the university students. Personal emails to and from the academic mentors can provide a line of communication between junior high school participants and academic mentors. A self-contained asynchronous and synchronous email system is the only option for pupil communications within this program. WebCT has the three types of asynchronous and synchronous communication desired for this program within a safe, self-contained environment for junior high students.

Future Prospects

Other features desired in WebCT include the calendar, participant homepage creation, and quiz. The calendar will allow junior high school teachers and university students to collaboratively research and plan Texas Essential Knowledge and Skills (TEKS) standard-based lessons. University students can periodically check the calendar to find project themes and teachers' email to collaboratively plan any projects that can be used in the university student's classes and in the junior high school teacher's curriculum. A discussion group will be reserved for teachers and university students to exchange ideas and resources in the development of such pages. Participants will also be able to post original homepage creations. This may result from the discussion group's shared ideas and resources. Fully completed homepages will be posted to the main homepage of the web site for other Texas educators to review.

Finally, the program directors have begun collaborative efforts with the university's college of education to develop a Virtual Professional Development School (VPDS), which places preservice educators' lesson plans on the World Wide Web for K-12 educator use. Future goals include further development with the VPDS environment and its inclusion in the college's imminent professional development school (PDS) and the preservice education program.

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Elements of Case Design for Hypermedia Environments in Teacher Education

Matthew J. Koehler, Anthony J. Petrosino, Richard Lehrer
Wisconsin Center for Education Research
1025 W. Johnson St.
Madison, WI, 53706
mkoehler@students.wisc.edu, ajpetrosino@facstaff.wisc.edu, lehrer@macc.wisc.edu

Introduction

Our interest in the design of cases is motivated by the need to develop tools for elementary teachers that will help them understand how students think about forms of mathematics typically unfamiliar to teachers, like geometry, space or measure. In designing case-based hypermedia tools, our goals are to exemplify not only student thinking, but also, core mathematical ideas. We agree with others (Merseth, 1996; Barnett & Friedman, 1997) that case-based methods for teacher education afford opportunities to develop knowledge of exemplary practices and to learn how to analyze and reflect about classroom contexts. Building off of our earlier work that focused on the design of mostly example-based hypermedia systems that helped teachers to learn (Koehler & Lehrer, 1998), we have developed a small number of design principles for selection and development of cases for case-based hypermedia systems for teachers. These design principles play a prominent role in our current work in progress in which we look closely at case-based hypermedia's role in the development of teachers' epistemology of measurement instruction in the primary grades.

Case Design

Following over five years of work in professional development conducted within the field of mathematics education, we have developed cases of *student reasoning* about elementary mathematics. Within this general locus, we have developed a number of selection principles for choosing among many hours of classroom video. These selection principles were informed by a triangulation of our previous years of experience, by literature in a variety of fields (cognitive psychology, education, educational technology, etc.), and by two empirical studies (Horvath 1998, Koehler & Lehrer, 1998). This triangulation has resulted in a set of design principles that at this point represent "lessons learned" that now guide our development efforts (Tab. 1).

Assessing the Design Principles

While our thinking about design principles for cases has been helpful, we found that these principles were of little use without an overarching design for the computer environment in which we planned to implement our professional development activities. Our previous work has suggested a small set of design principles that are important for creating hypermedia tools for teachers (see Koehler & Lehrer, 1998). The set of case design principles we have proposed here and elsewhere (Koehler, Petrosino, & Lehrer, 1998) are considered important next steps for incorporating cases into these hypermedia tools.

Our current efforts have focused on creating two versions of a hypermedia system aimed at helping elementary teachers think about measurement instruction in the primary grades. The first system is built around an earlier set of hypermedia design principles (Koehler & Lehrer, 1998). This system uses video footage primarily to exemplify the bigger ideas. The second system is being constructed in accordance with both the hypermedia design principles as well as the case design principles we have proposed here. Both of the systems share a large percentage of text and case video footage, but differ in the ways in which the video (cases) are used. Practically speaking, compared to video examples, video cases provide longer looks at classrooms, are accompanied by more interpretation, and have hypermedia links directly embedded in the digitized video to allow readers to explore ideas as they arise.

Studies in progress are aimed at investigating how participants using the case-based system differ from those using the example-based system on a variety of measures including: the ways in which they interact with the system itself, the order in which information is visited, how video is used, what is learned about the domain of measurement, what is learned about student thinking, and what is learned about classrooms.

Design Principle	Justification	Benefits
Cases Should be Grounded in Practice	Teaching is grounded in practice, so instructional cases about teaching should also be grounded in practice. It is for this reason that video cases should be created from footage that comes from real classrooms with full-time professional teachers	• Cases capture the richness and complexity of practice • Grounded cases are more realistic and relevant to practicing teachers
Cases Should Tell "Mathematics Stories"	We claim that cases are stories. As math stories, the actors should be teachers and students. The plot of the story should revolve around children's attempts, with the help of teachers to "mathematize" some aspect of experience and make sense of it. These stories can be historical, showing the development of children's thinking over time.	• Stories are engaging and more memorable • Stories facilitate the "mathematization" of experience • Stories can be used to show the history and development of student thinking
Cases Should be Annotated with Interpretation	Like stories, cases need to be interpreted: Video footage does not "speak for itself". Annotation should highlight the big ideas in the case: the encapsulated mathematics, the models of student thinking, and the decisions that teachers make.	• Interpretation helps teachers to understand the case • Interpretation helps teachers to see the big ideas contained within the case
Cases Should Anchor Further Exploration	Cases should anchor further exploration into other episodes of learning [CTGV 1990]. Episodes anchored to the main story line of the case provide a more varied developmental landscape than might be expected by simply following the main lines of the case narrative. Thus, cases should provide opportunities to explore both the current and related topics in depth.	• Cases can provide both the details of learning as well as the big picture • Cases permit connections to related ideas, other teachers, and other classrooms.

Table 1: Design Principles for Cases

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From Chalkboard to Chatroom: A Novice's Guide

Dr. Shahron Williams van Rooij, Ph.D., C.D.E.P.
Academic Product Manager
Datatel, Inc., USA
E-mail: svr@datatel.com

As the growth in the number of institutions offering web-based courses continues, faculty members are becoming increasingly challenged by the need to balance sound pedagogical strategy with the dynamics of the Internet environment. Some faculty are embracing this challenge, volunteering to teach web-based courses and participating in every available opportunity to learn how best to incorporate technology into instruction. Others have been assigned to teach web-based courses, with turnaround times ranging from 6-months to only several weeks. With the exception of those technology early adopters who have themselves developed tools and systems for web-based education, most faculty members are relatively new to web-based teaching and have neither the time nor the inclination to undertake an in-depth assessment of courseware development tools. The image of 24 x 7 learning certainly has its appeal; however, for those faculty members making the transition from the traditional classroom to the cyber-classroom, the road is often rockier than was anticipated. This paper offers some suggestions on facilitating that transition.

Getting Started

A review of the basics of instructional design is a logical starting point. Learner goals and objectives, content and instructional method and strategy remain the key drivers. These in turn raise a sea of issues in terms of implementation via the web: student support, faculty support, text, lab and library resources, office hours, advising, and copyright. In addition, faculty members often have to juggle multiple roles, particularly in these days of premium IT resources. Those roles include subject matter expert, instructional designer, media specialist, classroom manager, and even first-line technical support. Nevertheless, the objective is to apply pedagogical best practices regardless of the method of course delivery [Spear 98a].

Criteria for Evaluating Courseware

There is hope on the horizon, however. Published guidelines and standards offer guidance through the maze of commercial and proprietary software products for developing web-based courses. In November 1997, the Midwestern Higher Education Commission (MHEC) Interactive Courseware Committee noted four key criteria for evaluating courseware [HREF1]. First, the courseware should provide well-organized and dynamic interactivity between the student and the course content, the student and the teacher/facilitator, and among students sharing the learning experience. The human-computer interface should also allow the instructor and the students to navigate the material easily and effectively. Second, the courseware should be consistent with current knowledge on learning theories and precepts, providing strong support for instruction and the instructor, and facilitating instructor involvement in the learning process. It should allow varying "time on task" in the learning process and allow variable levels of faculty mediation based on the student's progress. Next, the courseware should provide highly motivating learning environments. Asynchronous, non-linear presentation branching in response to interaction with the learner and independent exploration are essential. Finally, the courseware should be faculty-friendly. Faculty members should need only basic computer skills and focus largely on the content, not the technology.

Creating Course Content and Materials

Creating course materials is the most time consuming, resource-intensive portion of faculty workflow and there are a variety of shrink-wrap products for authoring. However, nearly all of the PC-based authoring programs require a fairly robust technology skill set to get beyond on-line page turning; few provide development assistance and none integrate or interface with the institution's back office administrative information systems. A good authoring tool should provide step-by-step creation methods, templates, sample Web pages that can be adapted for individual use, automatic generation of CGI scripts, and basic instruction for creating standard components [Hansen and Frick, 1997]. But the authoring tool should also be flexible enough to provide the functionality and the benefits of multimedia tools and integrate seamlessly into whatever course management system the institution has selected.

Faculty members should take stock of the materials they currently have. While digitizing dog-eared lecture notes and putting them out on the web is certainly not the best approach, we need not throw the baby out with the bath water. Ideally, faculty would like to be able to gather their materials and place them in a "treasure chest" of resources that could be organized dynamically for use in web-based teaching and learning. Microcosm, a windows-based authoring software program, allows faculty to do exactly that [HREF2]. Created by a university consortium in the United Kingdom and winner of several international awards, Microcosm offers a repository from which a faculty member can create the same kind of multimedia, interactive courseware that a professional developer produces, but without the developer. The software allows faculty to integrate information and create courseware from virtually any resource, without having to learn programming. Instead of having to translate resources to suit the proprietary formats that most authoring tools use, Microcosm uses a series of built-in viewers to access the resource files. For example, there are viewers for each of the MS Office applications, for GIF and JPEG files, etc. When an instructor creates hypertext links, the links are stored separately from the data in their own link database. This means that the resource materials can remain in their native formats and in their native locations. Moreover, the courseware can be created and utilized in a non-linear fashion. Instead of page-turning, linear instruction, the course design is interactive and learner-centered. Task cards and wizards in plain English step the faculty through the process, with lots of positive reinforcement along the way. The structured "treasure chest" can then be "dropped" into the institution internet course management system via a Publish-&-Go wizard. At the moment, Microcosm is being evaluated by a group of colleges and universities in the United States.

Summary

To navigate the maze of products and ideas about tools for web-based course development, faculty members should keep their options open. Experimentation often reveals unexpected results, not the least of which is the lessons learned about a particular product or approach. Listservs such as ITFORUM and WWWDEV welcome all those interested in sharing ideas or simply seeing help in coping with the dynamics of education and technology. Importantly, students are an excellent resource. Computer Science faculty members have long known that getting students involved in the design of their own web-based courses is a win-win situation for both parties. Finally, to be called a technology novice is not an insult. The novice's open mind and freshness have traditionally been the engine behind the evolution of approaches discovered by the innovators and developed by the early adopters. The novice approaches the chalkboard and the chatroom in a positive fashion.

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[HREF1] MHEC Home Page
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Co-operative Multimedia Authoring: European Logisticians and Their Educational Network

Gaby Neumann, Dietrich Ziems
Department of Logistics and Materials Handling Engineering
University of Magdeburg
P.O. Box 4120
D-39016 Magdeburg, Germany
E-mail: Gaby.Neumann@mb.uni-magdeburg.de

LogNet – The idea of a network to support logistics education

Some years ago, the on-going practical use of computer-based methods for planning, controlling and managing processes in industry and business as well as the availability of modern information and communication technologies at universities encouraged the development of an educational system tailor-made for the specific interests of university-level logistics education. As result of a long-lasting, ineffective and discontinuous developmental process a first small module was implemented in English and German language which was of interest to logistics educators from more than 20 universities and colleges from all over Europe. In the same time, students and educators who had tested, used and evaluated this "product" have been coming up with lots of comments, ideas and wishes for improvement and extension. But as we learned from experience, further developments of any kind (i. e. translation, modification, adaptation, or extension) would only become possible in a collaborative developmental process of internationally distributed authors on the basis of a joint communication network.

Realizing this tremendous demand for collaboration in developing educational multimedia, the idea of an educational network of persons and institutions engaged in logistics education and interested in supporting it by use of multimedia and information technologies (LogNet) arose. Since logistics educators are often not very familiar with those so-called new technologies and their potentials or limitations, the network must first of all bring together interested people and provide them with structured information about the technical and pedagogical state-of-the-art in educational multimedia, its development and use. So, first activities concentrate on organizing teacher training on these aspects. In addition to this LogNet wants to make multimedia resources of different logistics topics, educational targets, complexity, and forms of knowledge presentation available to logistics educators and to encourage the discussion about concepts for their use. As the overall objective the initiative is focused on initiating, setting up and establishing a co-operative, distributed development of educational multimedia in the field of logistics and enabling logistics educators to introduce those kinds of technologies to their educational processes as knowledgeable consumers or well acquainted supervisors or even to become enthusiastic multimedia developers.

For this, the network follows two different strategies: In the old, traditional way workshops, user group meetings and summer schools will frequently be organized to enable face-to-face contacts. In the new, modern way an Internet-based infrastructure will support all information, communication, collaboration, and exchange processes by forming a virtual community. Especially the latter requires to think in more detail about how to organize those kinds of distance training and co-operative developments.

The LogNet server – Logistics behind the logisticians' educational network

From a logistics point of view this educational network of logisticians can be seen as a structure of nodes and links (relationships) between them (both together forming the logistics system), that has to store, transfer, and handle objects (in a logistics process). Following fundamental logistics principles the network then must work in a way that it comfortably provides users with information, knowledge, and services in a purposeful, customized manner appropriate to the users' needs and intentions. As most reasonable solution for this an Internet-based infrastructure can be seen which should have a powerful heart for the purpose mentioned above – the LogNet server.

The LogNet server can be characterized as a forum for discussion, communication, and exchange in the form of an open information system. It is closely oriented towards the providing of maximum support to logistics educators and consists of three major sections: Information, application, and collaboration. The first section provides the user with general information about multimedia in logistics education and scenarios for its use, but also information about multimedia applications available to support logistics education as well as an overview of results from their evaluation. On the other hand it serves as meeting point of interested persons or institutions and news stand containing latest publications, conference reports and announcements, or other links of interest.

The application section deals with all aspects relevant for using multimedia material: This touches not only administrative information about the conditions for using and/or evaluating available educational systems, but also instructions about how to use or how to evaluate them including corresponding teacher training information and material. Last but not least, it contains a multilingual collection of educational multimedia on different logistics aspects and multimedia resources of varying complexity available in a knowledge pool and ready for being used.

This pool of resources forms also a very important component of an environment for supporting collaboration in multimedia authoring, which is the third main section of the LogNet server. The structure of this section is similar to the application section. It provides also both administrative information (e. g. possibilities and conditions for translating or expanding existing educational modules or creating a new one) as well as instructions and training material (in this case about how to work and which basic concepts and general guidelines are suggested to be followed). Authors could also get access to a collection of multimedia resources available for being translated or adapted. These modifiable resources represent a subset of the usable resources accessible from the application section. And in the other way round, all newly developed or modified resources have to be described in a way that they can become part of the knowledge pool and are available for use.

In this way the LogNet server is not only a stock of information, but also a framework for education and training as well as for enabling collaboration in distributed authoring processes. That is why it has to provide multiple functions within a user-friendly designed, context-sensitive operating management infrastructure.

Results so far, steps to do next and problems remaining for the future

Despite it was growing step-by-step the educational network is still in its infancy: At the moment its nature is changing from being a user group to becoming a supportive developmental (authoring) environment. This mutation is directly driven by the LogNet members themselves and their wishes, because the availability of the existing multimedia module in further languages and its adaptation or extension in contents becomes more and more important for its wider spreading. These kinds of activities are organized in two phases to separate the modification of resources from changing the application. For this, the developers are provided with the appropriate (original) resources via file transfer, which they translate or adapt according to general guidelines. These new resources are sent back to the original team of developers, who finally embed them into the existing module and make this new application available for further use.

Next steps we are going to do will aim on setting up the LogNet server and bringing some life into it by creating the initial stage of a pool of multimedia resources including the required management infrastructure. While the LogNet server in general will also work as the network's shop-window to the world, the access to the pool of resources will be limited to those LogNet members who play an active role in filling it. At the conference we will demonstrate this progress and report about lessons learned from the server's implementation and use. With this, special attention will be paid on explaining which criteria will have been proved as most suitable for describing and identifying resources as a particular piece of software containing a particular aspect of logistics knowledge and being usable for a specific category of students as well as a certain educational target.

But there are lots of additional problems remaining for future work. Some of them like e. g. the development of a comfortable environment enabling real co-operative authoring in the Internet, the definition of assisting guidelines from the pedagogical, software engineering or design point of view, or the creation of an evaluation procedure and technical framework for guaranteeing high quality of multimedia teaching and learning resources are still a matter of research. Other questions like e. g. the handling of copy rights should rather be the subject of more global agreements. And the financial perspective which is of special importance for future developments leads to the vision of transforming this mainly idealism-driven server into a self-supporting service.

Art and Technology integration:
Activity theory and after school multimedia education

J. David Betts, Ph.D.
University of Arizona
College of Education, Room 505
Tucson, AZ 85721
bettsj@u.arizona.edu

The Multimedia Arts Education Program at the Tucson Pima Arts Council in Tucson, AZ is a five-semester after school arts technology program for low-income middle school urban youth. This paper is based on the first year of a longitudinal study designed principally to determine the effects of the program on the high school careers and upon graduation rates of students who complete the program. Most started the 600-hour program as sixth graders. They finished their work in the five labs within two years, including a summer semester. Graduates earned skills and experience in art technology, and, on graduation, a computer of their own. Along the way they write, draw, shoot video, and use computers to design graphics, publish stories and articles, and create animations.

Our lens for this study is activity theory. Activity theory allows us to look at this group of teachers and learners as agents-in-a-context, in a Vygotskian cultural-historical sense, who are engaged in tool-mediated, goal directed action. Agency, context and genetic, or historical, development are the focus of this look at an apparently successful program for young people.

Population

Eight to ten middle school students are enrolled in each of the five labs each semester. Most are Hispanic and bi-lingual to some extent. Many come from single parent homes in the downtown areas of Tucson. Their families must qualify for free or reduced lunch program at their schools, and not have a computer at home. A balance of male and female students is maintained through admissions processes. Students are required to maintain a "c" average in school in order to continue in MAEP.

Students receive small educational incentives each semester for attaining the required skill levels ($25) and completing their independent projects ($25). Upon completion of the program, each student receives a desktop computer of his or her own.

Activity theory

Activity theory as a methodology can provide an integrating framework for linking a set of principals (Nardi, 1998) such as the concept of computers as mediating tools which allow us to interact with our environments. Activity theory (Rubtsov & Margolis, 1996) proposes that a learning environment can be best understood by taking activity as a unit of measurement. Activity includes working with others inside a system of culturally defined tools, signs, and symbols. Activity theory takes into account the goals and motives of the learners in the context of the setting and its social aspects.

"Activity theory holds that the integral units of human life - humans interacting with each other and the world - can be conceptualized as *activities* (Italics in original) which serve to fulfill distinctive motives." (Scribner, in Tobach, 1996, p. 231)

Activities have a structure consisting of motives, goals, actions and operations. Activity theory holds these to be the structural units of human behavior, and, accordingly, appropriate units of analysis for learning environments.

In the course of their *activities* in this setting, students engage in *actions*, such as designing and creating. The *operations*, which compose actions, may be both mental [learning new software] and behavioral [drawing]. Actions are carried out for particular purposes or *motives*. Students may wish to learn more about art technology, learn new computer skills. They may wish to please their parents, earn money, or get their own computer. Activities take place under particular conditions: in the multimedia lab, next to an art gallery, after school, and so on, and with particular technical means. In our case computers, cameras, application programs that support creativity in language arts, graphics, animation, etc. Activities are goal-directed. One salient *goal* for the students is the personal computer that will be theirs to take home when they graduate. Another is high school graduation. People engage in many activities concurrently. Activity theory accounts for learning in that as a task becomes automatized it forms part of an operation that upon mastery becomes an action that is part of an activity, which leads to goals.

Data collection

Our purpose was to gather information about the program in the contexts of the MAEP lab, the home, and the school. University students worked as teaching assistants in the labs doing participant observation focusing on activity patterns and the development of curriculum. Data is being analyzed for evidence of æsthetic response (Vygotsky, 1971) and correlation with student outcomes in terms of perceived self-efficacy and attitudes about art and technology.

Exit interviews were conducted with the graduating class during their final portfolio activity. Parents of graduates were interviewed to ascertain their awareness of the program, level of satisfaction and influences of the students' new skills on the family. Graduates and their parents will be interviewed again about eighteen months after graduation. English teachers at the high school were contacted.

Each semester students took pre- and post skills tests developed by their instructors. They completed questionnaires about their perceived self-efficacy (Bandura, 1993) and attitude. Students report on their favorite arts activities and books they've read, etc. Questions related to attitudes about collaboration, perceived self-efficacy in regard to creativity and technology, their expectations for the program, and their career plans. Each semester they worked with their teachers to fill out self-evaluations. Students and teachers kept reflective journals. In addition, students are evaluated by their teachers and evaluate their learning experience each semester. These young people produced high quality work in print and digital form, including graphic designs such as logos and story animations, poetry, newsletters and video programs

Summary

Parents reported that they were highly satisfied with the program and that the experience had helped their children mature. Students reported that they participated in the MAEP activities motivated by a new computer, a wish to learn new art skills, and to please their parents. Students learned to use the software programs as tools to design and produce. Many responded to the arts-based setting and enjoyed sketching a drawing by hand. The conditions of the class presented a unique opportunity to interact with peers. Students reported that they saw a benefit from the Language Arts lab in their English classes. The computer skills acquired were less often recognized by the students as advantageous in school, however, they were looking forward to taking more courses that utilized technology in high school and were more likely to select those courses for themselves.

Of course, this after school program takes place amid a great many other activities. Students and faculty each brought a history of educational experience and technological expertise with them and they each contributed to the culture of the MAEP and of each lab. The history and development of the students, the evolution of the program's rules and policies, the volatility of the technology all are a part of this equation and all are dynamic. This study hopes to shed some light on these phenomena. We have established the procedure for the longitudinal study. The exit interviews, the parent interviews, the role of the teaching assistants, the assembly of data from the various questionnaires are in place, and we have begun a baseline for further study.

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Supercharging Your Course: Repairing the Broken Web

Nancy A. Van Wagoner
Division of Continuing and Distance Education, Acadia University
nancy.vanwagoner@acadiau.ca
Kevin A. Deveau
Division of Continuing and Distance Education, Acadia University
kevin.deveau@acadiau.ca
Shawna M. Smith
Division of Continuing and Distance Education, Acadia University
shawna.smith@acadiau.ca

Introduction

Today, educators have the technology to create an exciting student-centered learning environment that: a) accommodates different learning styles; b) accommodates different rates of learning; c) provides learning in context; and d) broadens the choice of learning and teaching partners. Yet most of the computer-based and computer-assisted courses developed to date are little more than electronic textbooks or lectures. Many educators are only using multimedia and information technology to do the same old thing - modify print or lecture-based courses, which are linear in their design - to a computer-based equivalent enhanced only with hyperlinks. This is not good education, and it does not address the learning style of many of today's youth.

Through computer games and programs like ICQ, today's student is accustomed to the interactivity that the computer and computer networks provide. They are accustomed to being able to complete a variety of tasks on a computer without referring to an instruction manual. They leap into games and scenarios going to the 'help' screens only when hopelessly lost and when the program is interesting enough to make it worthwhile. Mature distance learners are generally very busy with other responsibilities and commitments. They commonly have some level of practical experience in the discipline they are studying, and become frustrated by vast quantities of seemingly irrelevant on-line reading.

Philosophy/Concept

We believe that the real power of the computing environment in teaching is the ability to create real-life scenarios that engage the learner. Through the process of solving problems posed in a scenario, the mentor ensures that students have, or will acquire a basic set of skills or knowledge. The use of virtually unlimited navigation paths, along with multimedia presentation, and controlled access to information, allows the course developer to create a stimulating and positive learning experience for all students. This environment allows for learning to take place within a real-life context, and accommodates the different ways and rates students learn.

Project EdEx

With this in mind, Acadia University's Division of Continuing and Distance Education has embarked on project EdEx. The goal is to create a single prototype course which harnesses the power of the computing environment, and focuses on student-centered learning. Through the development of prototype courses we can develop a template that encourages instructors to break the old habits of "sage on the stage", and become the "guide on the side".

The development of these courses goes through stages. First, working with instructors, we establish the objectives for the entire course, and for the individual course modules. The second, and most important phase of the project, is identifying a series of problems or scenarios that: a) are relevant and current, b) are interesting and captivating, c) require students to apply a specific knowledge set, and d) require students to interact with learning and teaching partners anywhere on the planet. Finally, we use today's technology to present the scenarios.

As a prototype we are using a combination of HTML and Authorware to develop an environmental geology course. The course adopts a modular approach with each module incorporating a major topic area, e.g. geological hazards, earth resources, etc. The course is designed so students begin with a particular problem or scenario - not a lecture, and then access information as required to complete the tasks.

In each module, students face simulations of 'real-life' problems encountered by environmental geologists. For example, the student may be faced with the problem of building a shopping mall in southern Quebec. In order to make an informed decision about whether the mall should be built and the best location, students need to have knowledge of several key geological concepts, e.g. rock classification, geological environments, mass wasting, soil processes, etc.

As the level of prior knowledge for each student varies, the course is designed with all of the learning options up front so students may choose the one(s) they need to pursue. The problems are designed so that students must apply correct knowledge and concepts, but may enter the knowledge windows and help areas of their choice. Those who know how to identify rocks, for example, are not required to wade through the information presented on rock identification before continuing the scenario. To avoid the misconceptions which are often associated with prior knowledge, students will be required to periodically demonstrate a certain level of understanding before advancing to the next stage of the problem.

The scenarios and knowledge banks all take advantage of multimedia to accommodate different ways students learn. They can "see it", "hear it", and virtually "try it".

In order to develop cross-platform courseware we chose to use HTML as the front end of the course. Students can run the entire course through their browser with the QuickTime 3.0 and Authorware Shockwave plug-ins. Taking this approach allows us to deliver the course via the Internet and on CD-ROM, the latter being the more desirable approach. Menu options and navigation will be conducted through the HTML interface, with the interactive component of each module being controlled through a combination of HTML and Macromedia Authorware. Courseware developers without these tools should not be deterred from this model. Although the tools are an important factor in constructing the course, the key is the idea that students need to have ownership and control over their learning. The 'repaired' web allows courseware developers to give this control of learning back to the student.

We are very excited by this approach. By working through several prototypes our end goals are to develop a template that University instructors can adapt to any course, and to support a more dynamic learning environment both on and off campus.

DEVELOPING THE EASTERN VIRGINIA TELEMEDICINE NETWORK: SURPRISES ALONG THE WAY

C. Donald Combs, Ph.D.
Vice President for Planning and Program Development
Eastern Virginia Medical School
Norfolk, Virginia, U.S.A
Combs@planning.evms.edu

The Eastern Virginia Telemedicine Network (EVTN) is a health professions' distance learning, teleconsultation, and clinical telemedicine network established by the Eastern Virginia Medical School (EVMS) and the Eastern Shore Rural Health System, Inc., with major funding support provided by the Virginia Health Care Foundation, EVMS, and the Eastern Virginia Area Health Education Center (EVAHEC).

The network consists of two distinct telecommunications links between the Norfolk campus of EVMS and the greater eastern Virginia community. The first network utilizes a one-way video signal transmitted via microwave from EVMS to the control room of WHRO, the eastern Virginia public television station. WHRO then rebroadcasts this video signal over its wireless cable network throughout eastern Virginia. Participating institutions receiving this signal include hospitals, health departments, community health centers, community colleges, multi-physician private practice groups, and others. Viewers who would like to ask a question of the presenters, during a Grand Rounds session for example, direct-dial in to the EVMS studio over a toll-free telephone line. The second network consists of a two-way video, two-way audio, videoconferencing network linking many of the same institutional partners over digital telephone lines that allows for ad hoc communications to encourage teleconsultation among providers, to support health professions' student training in medically underserved areas, and to facilitate clinical telemedicine activities in the coming years.

The Eastern Virginia Telemedicine Network was established for several reasons: First, to improve the recruitment and retention of primary care health providers in medically underserved areas of eastern Virginia by reducing their sense of professional isolation. Second, to support the training of new primary care health providers in these areas by increasing the opportunity for health professions' students to train in those remote areas while being linked to their educational programs for didactic sessions. Third, to improve the quality of care provided in these areas by providing the most current medical information to providers and by increasing the amount of professional consultation among community and academic health center professionals. Fourth, the EVTN will ultimately reduce the cost of health care in remote areas by eliminating unnecessary patient referrals to distant treatment centers.

The Eastern Virginia Telemedicine Network provides a variety of programming to diverse audiences. Grand Rounds sessions at the academic health center are made available to a wider audience of health professionals in eastern Virginia, providing them with the opportunity to receive continuing professional education credits through program viewing. Health education programming will also be made available over the network to consumers of health care services in eastern Virginia. Quality health care programming produced by other entities throughout the United States, and indeed, the world, have been downlinked utilizing EVTN satellite facilities at EVMS and rebroadcast to eastern Virginia health providers and consumer viewers over the EVTN.

During the two-year development of the EVTN, a variety of surprises happened. These surprises involved factors such as the challenges posed by using existing space originally designed for other purposes; by working with limited (but adequate) funding; by technical integration; by long-standing presentation habits of faculty; by accreditation constraints; and by divergent concepts of need. Yet, the EVTN works. This presentation describes the development process and the lessons learned so that future development efforts might suffer fewer surprises – both technical and human.

EASTERN VIRGINIA TELEMEDICINE NETWORK "LESSONS LEARNED"

1. Unless you are a techno-whiz, utilize a technology consultant to help you.
2. Utilize a consultant who is unbiased concerning telecommunications medium and hardware selection.
3. Attend national conferences on telemedicine and distance learning—also good hunting grounds to find a consultant.
4. Attend a minimum of 20 sessions of whatever type of program—classes, Grand Rounds, etc., you want to broadcast before talking to a consultant.
5. Write down for the consultant the functionalities you want your project to accomplish.
6. Make sure that the audio portion of the project is not forgotten due to the usual focus on the video portion of the project.
7. Schedule construction work during organizational "down-times", such as summers and winter breaks for educational organizations, to minimize disruption.
8. Prioritize project tasks so that the most time-consuming tasks, i.e., communications licensing issues, accreditation issues, are handled first.
9. Don't underestimate the impact that small changes in audio-visual equipment will have on presenters using the new equipment.
10. Don't underestimate the impact that non-technical human factors can have on the success or failure of your project.

Coaching Educators to Use Telecommunications: Lessons Learned from a Statewide Telecommunications Education Training Project

Janis H. Bruwelheide, Ed.D.
Professor
Project Director, US WEST Montana Teacher Network
College of Education, Health, and Human Development
Montana State University-Bozeman
United States
janisb@montana.edu

Background

The US WEST Montana Teacher Network (hereafter referred to as the MTN) is a project funded by US WEST as part of its Teacher Networks initiative. Beginning in 1995 and ending in 2000, the US WEST Foundation has provided funding on a competitive basis to help one percent of the teaching force in each of its fourteen state region prepare to use telecommunications and to train an additional ten percent of the state teachers through peer coaching and training. States were brought into the projects on a phased basis. The lead states which served as pilots and received the first wave of funding in 1995 were Colorado, Idaho, and Utah. Montana is a part of the second group of states to be funded. The third group of states received its initial funding in 1998. A goal of all of the projects was to prepare eleven percent of each state's teachers to use telecommunications in schools.

State affiliates of the National Education Association worked with state US WEST teams to plan and implement the networks. Each state was given funds to provide one percent of the teaching force in each state with a notebook computer, a graduate course in using telecommunications, and online support and networking to facilitate the peer coaching of the additional ten percent of the teaching force. Some funding was also provided for administration, project evaluation, and participant expenses. The grantees and fiscal agents in the networks were to be schools or colleges of education although a few states were able to run the networks through a state office of public instruction or equivalent by partnering with schools or colleges of education. It was hoped that the states would be able to supplement project funding through other sources but this task usually proved difficult as many of the states are economically depressed and face tremendous geographical and telecommunications obstacles. However, the project teams and teachers have been very creative in delivering training and the projects have been successful.

Teachers have a great deal of subject knowledge and classroom expertise. However, they do not often have an opportunity to share what they know with colleagues in a networking manner when geographical challenges make physical meetings so difficult. Educators can feel very isolated--especially in smaller schools where h/she may be the only technology "guru." The beauty and power of the Montana Teacher Network is that in a low-cost manner, it is helping educators access a technology which will allow a far greater sharing of professional knowledge and allow them to also expand their personal professional development. Through its model of "peer coaching" in small groups or one on one, over 1300 Montana educators have learned to apply telecommunications technologies in their classrooms. Students and communities are the beneficiaries of such a model.

The Montana Teacher Network

Montana is a large, sparsely populated, economically depressed rural state with a <u>total</u> population of @ 800,000. This population translates into less than four people per square mile.

Geographic centers and populous areas are separated by vast land mass which is often mountainous. As a comparison, the sister city in Kumamoto, Japan, has over one million people. Travel in Montana is often difficult due to poor weather conditions during much of the year and air access is limited beyond a few cities. To provide a perspective of the size of Montana which is the fourth largest state, readers are informed that the entire New England states in the United States could fit into Montana physically and Montana is two thirds the size of France. Montana Office of Public Instruction data have indicated that the public school population, K-12, is @164,560. More than two-thirds of the public schools enroll fewer than two hundred students. In the 1996-97 school year, students were enrolled in schools ranging in size from 1 student to 2,400 students. In Montana, there are 56 counties and 900 public schools in 460 districts. School districts are located in an area the size of New Jersey, New York, Pennsylvania, and Ohio combined. These comparisons provide some perspective as to the challenges facing teachers to remain technologically current as well as the difficulties in providing training opportunities for teachers with or without credit attached. Thus, the opportunities and peer coaching approach provided through the Montana Teacher Network have filled a needed gap for professional development and training in Montana.

Montana State University-Bozeman is the fiscal and intellectual property agent for the Montana Teacher Network. During the first year of the project which began in late May, 1997, 132 teachers were selected through an application process to be the first wave of coaches. Each received a notebook computer for their use as long as they are public school teachers in Montana. The teachers were divided into five workshop groups to attend a three day summer workshop which provided an overview of telecommunications and hands-on Web basics. The workshop was the first part of a three credit course. Teachers could choose to take the course for graduate credit, renewal credits or not-for-credit. However, as part of the grant award participation , the teachers signed contracts to complete the course and grant requirements of "each one coach 10." by end of 1999. During summer, 1997, four workshops were held at the Montana State University-Bozeman, Burns Telecommunication Center in Bozeman. One workshop was held at the University of Montana campus.

The online course component began in September, 1997 and finished in May, 1998. It was delivered over MSULINK, a First Class Intranet Client computer conferencing software housed on a server at the Burns Telecommunication Center.

During the second year of the MTN project, the teacher coaches were required to execute their training plan for coaching at least ten peers in using telecommunications in education. A web site and MTN conference was established on the state telecommunication network, the METNET which uses First Class Intranet Client computer conferencing software with which the teachers were already familiar. The coaches and their ten colleagues had access to a wide variety of resources, information, and online conversation about incorporating online resources into their respective curricula and communities. The URL for the Montana Teacher Network is:
http://www.metnet.state.mt.us/~MTN/). The teachers also have access to all the information and resources available at the METNet website which can be accessed at the following URL: http://www.metnet.state.mt.us/MAIN.html. Since the First Class Intranet Client software is easy to learn and use, this vehicle fulfilled US WEST grant requirements of building on existing infrastructure and networks within a state since the METNet is housed on a server at the Montana Office of Public Instruction. In addition to serving education the METNet is used as the state server for government and other entities such as museums, projects, state information, and distance education opportunities offered by several higher education units in Montana.

To date, the Montana Teacher Network has been a success. Plans are underway to find additional financial support in order to expand the project to more educators and local communities. Teacher participants are being encouraged to present sessions at state and local educational conferences and meetings and to continue their peer coaching efforts and remain actively involved with the MTN website.

Technology Transfer and Web Course Augmentation Based on Learner Attributes

Dennis Moore, Ed.D. and Elizabeth M. Corbitt, Ph.D.
Wright State University
Eileen Wolkstein, Ph.D. and Rebecca Bausch, M.P.H.
New York University

Introduction

As education and training increasingly move into the realm of distance learning, research is needed to determine the impact of computer-based instruction on individual learning needs and styles. Whereas the ultimate goal for some settings is total technology transfer and electronic delivery of course materials, experiential and non-computerized interactive components have been shown to be important for many persons. This concept may be particularly applicable in fields demanding that active professionals upgrade their education despite the lack of appropriate degree granting programs immediately available. Thus, despite these professionals' potential difficulty in utilizing computer-based instruction, they may be constrained by circumstances to attempt this kind of course. Research on the effectiveness of different web course features for persons with different learning needs is therefore timely and of great potential utility. We are reporting the results of preliminary data based on a web course utilized as one component of a classroom course, hypothesizing that variables associated with learner characteristics would differentially influence learners' satisfaction with and successful completion of the web course.

Description of Web Course. The web course on which this research is based, entitled Drug Abuse, Disability, and Vocational Rehabilitation, has evolved from the work of the Rehabilitation Research and Training Center (RRTC) on Drugs and Disability, funded by the National Institute on Disability and Rehabilitation Research (NIDRR). Our epidemiology research has indicated a high prevalence of unidentified substance abuse among customers of Vocational Rehabilitation (VR) services, leading to higher failure rates and expenditures of funds without successful outcomes. Through meetings and training sessions with VR agencies across the country, a pressing need has emerged to inform counselors about the high rates of substance abuse, and to provide training in assessment, treatment planning, and VR counseling with customers with substance abuse issues. The decrease in training resources combined with advances in technology and the need to get information to more remote VR offices has led to the creation of this course.

Method

Participants in this pilot study were 37 individuals completing the web course in two separate classes (New York University, N = 20; Virginia Commonwealth University, N = 17) who filled out questionnaires before and after participation. Learners were graduate students in university rehabilitation departments, but had a wide range of backgrounds, including a number of professionals in the fields of substance abuse and/or vocational rehabilitation. When the course structure is finalized, learner characteristics, including age, gender, educational level, years post-matriculation, levels of computer expertise, and learning styles, will be measured on initial registration for the course. Outcome variables will include course grade, percentage of course completed, learner satisfaction with the course and with different aspects of the course, learner ratings of their own success and learning, and learner ratings of the utility of the course and of different course aspects. Additional course variables will also be measured, including time and frequency using various web course features, and level of participation in "real time" activities for course augmentation. For the purposes of this pilot study, outcome variables included course grade, and knowledge-based questions regarding course content, which were administered before and after course participation. A sub-sample of participants answered questions regarding their age and gender, as well as their satisfaction with the course, ratings of their own success, and ratings of the utility of face-to-face interactions in contributing to their course experience.

Results

For the NYU sample, age was negatively correlated with enjoyment of the computer at Time 1 ($r = -.75$, $p = .021$), and showed strong negative relationships to enjoyment of the internet ($r = -.544$, $p = .13$), comfort with using a computer ($r = -.597$, $p = .09$), and comfort with using the internet ($r = -.47$, $p = .20$). These correlations were no longer present at Time 2. For all participants at NYU, regardless of age, comfort with the internet increased significantly (mean T1=6.89, mean T2=8.32; $t = 2.19$, $p = .044$). Course grade was not related to comfort with computers or the internet. For the group analyses performed for the VCU sample, ratings of enjoyment of and comfort with computers and the internet increased between T1 and T2, with group means increasing from around 5 to around 7 on a 10-point scale for each of the four items (see Figure 1). An additional set of items related to knowledge of course material. For the NYU sample, the mean score of participants increased significantly from T1 to T2 (mean T1=6.6, mean T2=7.9; $t = 3.15$, $p = .005$). At VCU, the mean knowledge score increased from 5.3 at pretest to 6.6 at posttest. Knowledge scores were not related to comfort with computers or the internet at Time 1 or Time 2. Information regarding learner opinions regarding the utility of face-to-face meetings was collected for a small subsample of participants (N=9) at NYU on post-test. On a ten-point scale (where 1=extremely unimportant and 10=extremely important), these participants were highly variable in their responses, ranging from 1 to 10 (mode = 9).

Discussion

There currently exists a paucity of information regarding how specific elements of electronic learning differentially affect learner outcomes, especially as mediated by demographic and other learner attributes. The research reported in this paper relates to a web course that is likely to be offered to a number of simultaneous groups of traditional and non-traditional students in the future, and results from this study will be utilized in tailoring future revisions of the web course to groups of learners based on the modalities and approaches proven most efficacious for learner characteristics. These preliminary results suggest that older students may feel initially less comfortable with web-based learning, but become more comfortable with exposure. On the other hand, comfort with the computer or the internet did not appear to relate to course grade or to knowledge gained from the course. It is interesting to note as well that the two samples of students in this pilot investigation had different initial comfort/enjoyment levels with computers, suggesting that different classes will be quite variable. Although information regarding learner opinions regarding the utility of face-to-face meetings was collected for only a small subsample of participants, the high variability of responses was somewhat surprising, with answers ranging across both ends of the scale. While preliminary, these results suggest that learners do indeed have widely varying levels of comfort with computer-based learning, and may thus react quite differently to different course aspects.

VR Studying Business Education

Prof. Dr. Peter Baumgartner
Institute for Organisation and Learning (IOL)
Department of Business Education and Evaluation Research
University of Innsbruck (Austria)
peter.baumgartner@uibk.ac.at

Detlef Wydra
Wydra Grafik Design, Dortmund (Germany)
wydra@wydra.de

Introduction

At the department of business education and human resource management (University of Innsbruck; Austria) we offer all relevant information services for the students via the internet with a 3-D interface. Students (but also other visitors) can choose an avatar and move around in the virtual reality environment. They cannot only explore all the relevant information for their study in an interactive way, e.g. knocking at the door of a professor and asking for the outline of her lecture but they can also start the necessary action for the university administration, e.g. booking the lecture, download the literature etc.

This is a pilot project not on the technical but on the organizational level. Linking all the relevant information together is primarily an organizational task which will change the university structure. The project is embedded in a three year development project funded by the Austrian government which will restructure the whole university.

Background information

The University of Innsbruck, situated in the center of Innsbruck (130.000 inhabitants), has about 30.000 students. The faculty of Social and Economic Sciences has 5.000 students and consists of five major fields of studies: Business Administration, Economics, Business Education, International Economics and Business Studies and a doctoral program. The idea to build a virtual faculty is linked to three major university developments:

Firstly more autonomy for Austrian Universities. With a new law (University Organization Act 1993) all Austrian universities will get more autonomy in a transition period of about 10 year. Formerly all major decisions like budget, areas of specialization, appointment procedures were directed by the ministry of science in Vienna. Now we are building different university organs that will overtake these responsibilities. This process is very complex and has different phases; one of them is a kind of dual control of the old and new bodies. The new self-governing bodies are preparing their statutes but do not yet have the decision power for everyday business. The transfer of power from the old to the new bodies is a crucial process. Currently the University of Innsbruck is undergoing this difficult transition period.

Secondly, the move towards greater autonomy is accompanied by a strategic initiative of the senate (the self-governing body at the executive level at the university). In a three-year project, funded by the ministry of science, the members of the university are discussing organizational changes and future alternatives with regard to the content of services and performances. The main idea of this project is to motivate as many members of the university as possible to participate and cooperate in the transition process. Within the project ten different subgroups work on issues such as "Teaching & Research", "Personnel Management", "Central Information Services", "Financing & Controlling etc. One subgroup "New Media" investigates the future possibilities and organizational consequences of New Media for teaching and will provide the ruling body of the university with all the necessary information for strategic decisions.

Thirdly, in February the complete faculty has moved to a new building. This building was designed, constructed and built by a more than ten year participatory process. The new university building has not only already won some architectural prizes but has also led to a certain mood of awakening of faculty members.

Business Education as a virtual world

In this atmosphere of change our project tries to collect and concentrate all the different information for the studies of Business Education in one common interface. At the moment we have different approaches (database, booklets, internet services, introductory information by the faculty and student union, etc.) coming from different sources (ministry, center of EDP, initiatives of the department, individual information via a personal homepage, etc.). Most of this information is text-based with just a small amount of interactivity and time control. Redundant and complicated access to the relevant information are the consequences.

Virtual worlds are three-dimensional representations of objects in the space and their reproduction on display. To program virtual worlds the *Virtual Reality Modeling Language (acronym VRML)* is used as a standard platform-independent language for describing interactive 3-D objects and worlds delivered across the Internet.An extended type of the virtual worlds are the so-called *multi-user worlds*. In a multi-user world the visitors are shown by so-called avatars, so that visitors of multi-user worlds can see themselves among themselves.

This pilot project offers service performances for the students (in particular those in their first-year), the instructors and the administration. Beyond that it should also promote communication by using multimedia between instructors and students and among the students themselves. The three-dimensional reproduction of the faculty building and selected interiors and the virtual world resulting from it form the basis for the planned supplies and service performances. The information will also be callable in a pure HTML page version for faster access to the data.

Study plan: The compilation of the complicated study plan can be done comfortably from home by the accessible list of lectures and linked cgi-based HTML forms.
Virtual information: Students can receive closer information about lectures, seminars and exercises on-line at the virtual information boards. At any date modifications can be placed by the instructors. This up-to-date information can help to avoid unnecessary journeys.
Meeting allocation: At the virtual information boards the students can themselves into the lists for the respective meeting. This must not be done anymore at the real faculty in Innsbruck.
Email pool: By the collection of the email addresses of the students in an email pool, indicated for the entry to a meeting, the instructors and the students receive the possibility of taking up with all users of the appropriate meeting by email contact.
Virtual self-manifestation of the institute and its areas: Here instructors can publish up-to-date information about their institute e.g. research results, new book publications or job advertisements for projects, tutors or a scientific co-worker. Over an appropriate HTML form and email the application can be dispatched on-line.
Virtual consulting hour: In the lecture-free time the students can discuss any problems after previous log-on by HTML form with the instructors in the virtual consulting hour.
Virtual office for examination: Through a link to the examination office the students can check what documents are needed for the examination and request the missing ones by email or develop at least a precise routing plan to get all certificates.
Virtual communication: By the implementation of the virtual faculty as a multi-user world, the possibility of a communication among themselves exists for the students. When meeting at the points of information or in the cafeteria experiences can be exchanged, seminars be selected and occupied together.
Virtual "black boards": Students can enter themselves at the virtual black boards into different lists (room search, riding along opportunity, teaching materials etc.) and/or look up relevant information.

The administration of the updateable sections in the virtual faculty is made in each case by the responsible persons (e.g. office for examination, secretariat, instructors) over the Internet/Intranet by using a simple and self-describing interface. The updated virtual world is available directly, without further maintenance by a system administrator from the outside. A virtual information world developed in such a way can be administered by the users (the lecturers) themselves. When the system is accepted by students and faculty members it can be extended to other major field of studies, faculties or universities.

Global Warming: A Problem-Based Approach to Teaching Science

Jeffrey Bell, Department of Biology, California State University, Chico, jbell@csuchico.edu

James Pushnik, Department of Biology, California State University, Chico, jpushnik@csuchico.edu

Randy Miller, Department of Chemistry, California State University, Chico, rmmiller@csuchico.edu

There are a number of new issues that science educators have been grappling with over the past few years. Three of these issues are the introduction and increased use of educational technology in the classroom, the teaching of science in an integrated format, and the use of problem-based learning (Ramsey, 1997). To address these issues we have designed a course for non-science majors that is based on the very real problem of global warming, an issue of relevance to the students. To understand the various scientific issues involved in the global warming phenomenon necessitates a basic understanding of physics, chemistry, geoscience and biology, thus requiring an integrated approach to the sciences.

Presently, a student, whether a science major or not, receives an introduction to college-level science by taking a basic science course in one discipline, be it chemistry, biology, physics, or geoscience. It is perhaps only after several courses that students begin to be able to integrate knowledge across the sciences and see the larger, holistic picture - that the sciences have commonalties such as the scientific method, a need for quantifiable and verifiable data, the use of statistics and probabilities, and a healthy skepticism tied to the process of critical thinking. Only after several courses do students see the interface and overlap between chemistry and biology, geology and chemistry, physics and math, and the quantitative skills needed for good science. If they only take a couple of courses, they may never see this.

Problem based learning starts with the premise that students will learn better if they learn by solving ``real" problems as opposed to learning by rote memorization or solving artificial problems of little interest to the student (Arumbula-Greenfield, 1996). The sciences have always had a strong component of problem based learning in the traditional laboratory experiments. Unfortunately, two problems with the usual science laboratories are a lack of relevance to the student and little connection between one weeks experiments and the next, making it difficult for the student to tie everything together. Problems where the student wants to know the answer and needs to learn the science to find that answer are in very short supply.

Technology is critically important in almost all current scientific endeavors, however, little of this technology can be found in the typical undergraduate science laboratory, especially in classes for non-majors. Two explanations for this are the expense of the technology and the lack of time and motivation for the students to learn proper use of the technology. Current scientific problems and access to the appropriate equipment for studying these problems is needed to teach modern science.

With funding from the NSF we have designed a course organized around the scientific controversy of global warming. This course will introduce the students, both science majors and not, to the scientific method. Emphasis is placed on the collection and analyses of data, simple statistical evaluations and basic mathematical modeling techniques. This approach encourages the evaluation of ideas and critical thinking, questioning, hypothesis testing, and theories vs. hypotheses, all related to the same scientific and societal problem. By focusing the course on an extensive and complex issue, basic concepts and principles of science will arise naturally through the student's inquiry-based investigations and attempts to understand the various problems involved in the issue. Using a theme such as global warming, they will discover that they need to learn about concepts such as radiation, photosynthesis, the greenhouse effect, gas absorption, and the laws of thermodynamics. They will also have to consider the implications of this knowledge, and the limits of our current knowledge. An added benefit of studying a complex problem such as global warming is that, in addition to teaching some basic science, it will introduce the students to some of the techniques for dealing with complex systems, in particular, systems thinking and the use of dynamic models.

An introduction to systems thinking and mathematical modeling of global warming will be accomplished with the modeling program Stella®. A team of students, at the culmination of the course, will demonstrate and justify the final form of their model. The subject area of each scientific discipline would be substantially represented in the simulation. Chemistry will be represented by information, data, and interactive demonstrations on carbon dioxide, photochemical reactions, and gaseous exchange between air and water. Physics will have instructional components dealing with radiation, the greenhouse effect, and thermal loading. Geoscience will be represented by information on volcanic activity, precipitation data, satellite images, the use of fossil fuels, and long-term climate projections. Biology would have data on photosynthesis, the effects of deforestation on the atmosphere, and simulations of plant growth in varying concentrations of carbon dioxide. Mathematics will be represented in all of these areas as students learn how to quantify various aspects of the model using basic mathematical modeling techniques. Students will access data from satellite photos and international databases available over the web, these will be integrated into their models along with their own experiments in the laboratory.

The goal of the course is to stimulate students to learn science by becoming involved in a large, complex scientific problem that requires their actively learning many aspects of science in their efforts to find a solution to the problem. The specific problem for the students will be to determine the atmospheric composition, global temperature, and effect on the planet of a fifty-year period of carbon dioxide increases. They will create a model of biogeochemical cycles and weather phenomena, and collect information on fossil fuel use, methane generated by cattle feedlots and biomass burning, CFCs, etc. They will use their textbook, their instructor, the WWW, the results of their experiments, and specific data sources posted by instructors to gather information. Then they will use the modeling program to analyze the connections between these different components and to make predictions. In the process of solving this problem, students would have to understand and interrelate a variety of ideas without the typical discipline-based focus.

Students will do various experiments to learn about the scientific method and how experiments can be designed and used to quantify the parameters and relationships that interact to determine the earth's temperature. These will include black body experiments, infrared absorption, solubility studies and measurements of photosynthesis and respiration. Students will analyze their results and incorporate the experimentally determined parameters into their models at computer workstations that will be part of the laboratory. A special laboratory is being constructed for this course and will include both computer workstations and traditional lab benches. This studio-type classroom/laboratory is similar to those used at other institutions such as Rensselaer Polytechnic Institute and California Polytechnic State University, San Luis Obispo.

Our eventual goal is to use educational technology to teach science, and some math, in an integrated way by tying together several courses, faculty, and departments into an integrated curriculum which uses computer software simulations and models to help interrelate concepts, ideas, and principles across the science disciplines in a problem solving format. This curriculum, we believe, will address the needs of a wide variety of students with diverse backgrounds. Whether the students have a strong interest in math and science, are inadequately prepared, or have little interest or aptitude in math and science, the format of this course will encourage them to become deeply involved in the processes of science.

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Educational Multimedia Accessibility and the Americans with Disabilities Act

By Scott Standifer, Media Specialist & Instructional Designer, Region 7 Rehabilitation Continuing Education Program, University of Missouri, Columbia, Missouri, USA. C529163@showme.missouri.edu

An informal poll at the 1998 EDMEDIA conference suggested that there is little awareness of disability access issues among AACE members. A report by the US National Council on Disability (1998) reported a similar lack of awareness among US multimedia developers. The NCD report also found that most multimedia developers were happy to comply with accessibility guidelines once the issues were explained. This paper is intended to raise awareness of disability access issues and point readers to resources for more specific information on achieving accessibility.

When asked about disability access, developers at the 1998 EDMEDIA conference gave two consistent responses: "People with disabilities are not part of our audience" and, "It is too difficult to accommodate them." These objections are both incorrect and, in many countries, illegal.

"Not Our Audience" - The Moral and Legal Mandate

The US National Council on Disability (1996a) called people with disabilities the largest minority group in the United States. There are an estimated 30 million US citizens with functional disabilities that limit their access to multimedia products (Vanderheiden 1990). The abilities and interests of this population are as diverse as those of the "normal" population. It is unlikely that any educational topic addressed by a multimedia product will not be of interest to some individuals with disabilities.

The proportion of the population that experiences functional disabilities rises dramatically with age, from 10% of adults age 25 to 34, to 45% of adults age 65, and 72% for adults aged 75 and older (Vanderheiden 1990). These figures suggest that the number of people with disabilities will dramatically rise as the US population ages. These figures also suggest that the odds of any particular individual (such as the reader) needing accommodations increases as that individual ages.

Different disabilities will limit in different ways a person's ability to interact with multimedia software. Relevant sensory disabilities include low vision, blindness, color blindness, reduced hearing, and deafness. Relevant physical disabilities that limit a person's fine muscle control and hand-eye coordination include spinal cord injuries, arthritis, cerebral palsy, various degenerative nerve and muscle conditions and other disorders. A variety of cognitive disabilities can limit how well an individual deals with rapidly changing situations.

Several researchers have pointed out that accommodation features for people with disabilities often improve a product's general utility (Bergman & Johnson 1995; Newell 1995). One classic case is sidewalk curbcuts for wheelchair access. Unexpectedly, curbcuts have also improved access for people pushing strollers, shopping carts, movers' dollies, or any wheeled device. Another example is books on tape that were originally developed as an accommodation for the blind but are now widely used by people on long car trips.

The latter example illustrates that, in some situations, individuals without a disability may have situational limitations similar to individuals with a disability. The driver of a car is visually limited by the need to watch the road. Similarly, accommodations for color blindness in a computer interface will also solve potential problems of users with black and white monitors. Alternative text-based versions of Web pages to accommodate individuals with vision problems will also improve access for individuals with slow modem connections. Captioned video clips for users with hearing loss will also improve use for individuals viewing in a quiet library or a very noisy computer lab. The provision of information in multiple formats (audio, graphic, text, etc.) from which the user can choose is useful to accommodate both users with different disabilities and users with different learning styles. Because of these general utility aspects, some researchers call computer accessibility features "electronic curbcuts" (Bergman & Johnson 1995; Campbell & Waddell 1997)

The archetype for many laws regarding disability access is the US's Americans With Disabilities Act (ADA) passed in 1990. This law requires (among other things) that all public facilities and services be accessible to people with disabilities. In the wake of this law, it has become standard in many US universities to include on course syllabi a statement describing the right of any student to accommodation for a disability. This has direct relevance to educational multimedia products. Any US educational institution that purchases or develops a computer-based educational product that is not accessible to individuals with disabilities is open to a lawsuit under the ADA.

Over the last decade, many countries have passed similar laws requiring access and accommodation for people with disabilities, including Australia, New Zealand, Canada and Britain. There is no single list of countries with such laws, but it is likely most countries have them at least on the books (personal communication, Mark Behrendt, World Institute on Disability, February 1999).

"Accommodation is too difficult"

The ADA and similar laws do not require expensive, burdensome accommodations for all possible disabilities. Instead, the ADA requires that software developers make a "reasonable" effort. Put another way, if there is something basic that is not too hard to do, you need to do it. What a developer cannot do is claim that nothing can be done. If access issues are addressed early in the development process, solutions are generally simple and inexpensive to implement. Accommodation only becomes expensive if it is left until after the product is finished.

The ideal approach to accommodation is built-in access to multiple media formats within the product. This "universal design" concept is most appropriate to developers working "from scratch" on entirely new software products that do not depend on existing software platforms. Approaches to universal design are currently the focus of more literature than can be reviewed here. A list of resources is available at the author's website at tiger.coe.missouri.edu/~rcep7/access.

A second approach, "Adaptive accommodation, " depends on the use of third party "accommodation software" (National Council on Disability 1996b; Bergman & Johnson 1995). There are many types of accommodation software products, ranging from screen readers and Braille readers for the blind to alternative mouse and keyboard controls for those with physical disabilities. Resources for such software are also at the author's website. If developers provide features accessible to these programs, a variety of disabilities can be accommodated to some extent. Below are some general guideline for developers and educators using adaptive accommodation:

1. Provide ASCII text (or text-only) alternatives for all information. ASCII text functions as a "presentation independent" format for a variety of accommodation software products. Many individuals with blindness use "screen reader" software that translates on-screen ASCII text to spoken language or Braille. Unfortunately, multiple-column text layouts can confuse screen readers. In addition, graphic images of text are inaccessible to screen readers. Developers should provide simple ASCII text files that accommodation software can accurately process. The problem of layouts has become especially significant in developing HTML accessibility guidelines. It should be noted that PDF files are not currently accessible to accommodation software.

2. Provide captioning and alternative audio tracks for video clips. Many video formats (including Quicktime and SMIL) now allow closed captioning of the narration for users with deafness. In addition, these formats allow an alternative audio track, similar to closed captioning, to provide additional descriptions for users with blindness. As mentioned, this can also prove useful for users in extremely noisy environments.

3. Provide text descriptions of all graphic and audio information. Besides text versions of images of text, text descriptions of all images, charts, and sounds must be provided. In HTML, use ALT labels for this.

4. Distinguish interface elements with more than one type of coding. Use a combination of media elements for all significant features of a multimedia product. If screen elements are distinguished only by different colors (colored parts of a map, for instance) people with color blindness may not be able to read it. This problem would also arise for people using a black and white monitor.

5. Be aware of local disability access resources. Many universities have disability access offices, which are a good source of information on accommodation software. The staff is frequently willing to demonstrate software and evaluate multimedia projects. Most educators and developers will find it enlightening to meet with the staff of a disability access office even before a specific need arises.

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Building Web Courses with Instructional Immediacy (www.telecommunication.msu.edu/faculty/larose/websection.htm)

Robert LaRose, Ph.D. (larose@pilot.msu.edu)

Pamela Whitten, Ph.D. (pwhitten@pilot.msu.edu)
Department of Telecommunication
Michigan State University
East Lansing, MI 48824, United States

Prior research on live classroom teaching in higher education has found that the degree of closeness between instructors and students, or *teacher immediacy* (Hackman & Walker, 1990) can increase affective learning (or student attitudes towards instruction), which in turn increases cognitive learning. Immediacy behaviors that are easy to perform in class are difficult to even imagine in a Web course, such as smiling at students and calling them by name. Earlier research (LaRose, Gregg & Eastin, 1999) showed that Web courses can match the immediacy of live instruction when at least some of these features are present. Interactions with other students and interactions with computers may also affect outcomes, we refer to these factors collectively as *instructional immediacy* (LaRose & Whitten, 1999). Here we examine how Web courses might be improved by assessing the state of the art, adding immediacy features to web courses and understanding the immediacy needs of learners on the Web.

Web Course Content Today

We searched the World Lecture Hall for standalone Web courses delivered during the 1998 calendar year and that had at least one of their lessons available for public viewing. We found 48 and performed a content analysis of their immediacy features using a standard coding guide that yielded 90 percent inter-coder reliability. Few courses employ the multimedia capabilities aside from providing hyperlinks to additional information. Only a third include graphics in their lessons while less than 10 percent used video or animations and none of the courses used audio lessons. Aside from providing an email address, publication of the instructor's phone number was the only course-level immediacy feature found in over half the cases, although discussion areas are common to about a third. Few courses invite student contact outside of scheduled office hours. About two-fifths attempt to convey the personality of the instructor by posting snapshots or personal information. Opportunities for student interaction are minimal. There was only a single instance of a "students only" communications option. The most common immediacy feature in the lessons themselves is content that refers to the class in the second person (e.g., by using "we" or "our"), a third of the lessons did that. Open-ended questions and (delayed) feedback on student quizzes and assignments are in only a fourth of the lessons. To quantify immediacy, we computed an additive index of 24 immediacy features and found an average of less than six per course. Our sample was limited to publicly accessible material and perhaps better ones are hidden behind password protection barriers. With the permission of their instructors, we peered behind the password barriers at five Web courses on our own campus. The five courses averaged 13 immediacy features each and one contained 21 of the 24 immediacy cues in our index. Informal comments from other Web instructors with whom we shared our results confirm that the best features are often hidden from public view.

Improving Web Course Immediacy

We asked a sample of net-savvy college students from one of our on-campus courses to visit three Web courses and to "think out loud" as they surfed. One was entirely text and graphics, a second added audio and a third had video. Then our surfers joined focus groups to identify characteristics of "best courses" in the conventional classroom mode and to compare them with Web courses. Immediate feedback is what students crave. They want instant feedback, even if limited to finding out the answer to a multiple choice question or to a "roll call" feature that acknowledges them by name. Email is insufficient, responses are too slow and it requires opening a separate application. One virtual instructor encouraged students to use the AOL "instant messenger" system so that they could reach him any time he was on-line. But the "Help" button needs to be ever present in the lessons and (ultimately) lead to a real person. Many comments related to text-laden lessons. It's hard to stay focused on text or static graphics, but attention wanders even with Web video -- especially the talking head variety common today. Changing visual course outlines add to immediacy by locating learners in the course. Animated gifs and mouseover events can help. Failing that, students want an easy way to print sections of the course (as opposed to each individual page) so they can read from paper. Learners also criticize marginally relevant links to volumnious text resources. Teacher immediacy comes from personal information about the instructor that invites learners to imagine what kind of people instructors are, especially candid personal information, snapshots and personal comments about lesson material. Chatrooms do not create sufficient immediacy with other students. Providing pictures and bios of students is a way of "getting to know" others better, but some of our female students had a problem with that. Navigation issues include dead and misdirected links and secondary browser windows that completely overlap the lesson page. An on-site search engine and basic navigation and instructor contact buttons on every lesson page are also desired. Learners also like to save notes on-line, automatically go back to where they left off in the previous session, and launch the next page automatically (i.e., instead of hitting the "next" button).

Reaching Nontraditional Learners

We sampled email addresses at random from Bigfoot and directed respondents to our Web survey site. We received 25 responses to our pretest that give a preliminary indication of the factors in Web course adoption. Half of our respondents are interested in taking courses over the Web. The convenience of taking courses whenever and wherever the learner might want are two important advantages of Web courses. General convenience, the ability to work at one's own pace, the elimination of travel to campus and the ability to take the course in different places also received multiple mentions. Other advantages included the ability to concentrate and organize better in the home environment and to get better feedback than in the conventional classroom. Most saw the loss of instructor and student interaction as major disadvantages. Concerns about the quality of Web instruction and the acceptance of credits by employers are also widespread. Other are concerned about the difficulty of reading text off the computer screen and typing out course interactions, overcoming the distractions of the home environment, finding the motivation for self-paced lessons, and obtaining technical help. According to our respondents, providing feedback and praise to students are the most important teacher immediacy needs, followed by the opportunity to hold conversations before class, asking questions of students, organizing activities outside of class and smiling at the class. Some of the instructor behaviors thought to increase immediacy in the classroom are not very important to potential Web students, including inviting contact outside the classroom, displaying a relaxed posture, gesturing and allowing students to call the instructor by his or her first name. Interactions with other students are not as important as interactions with instructors but two stand out: Garnering praise from other students and having others sit near you in class.

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Experiences in Distance Education
The Authoring Dilemma

Karen A. Lemone
Computer Science Department
Worcester Polytechnic Institute
Worcester, MA 01609
kal@cs.wpi.edu

1. Introduction

WebReCourse [5], the Retargetable Course Generator enables creation and reuse of Web courses. It is a secure software system for online course management, allowing instructors to increase the accessibility of online course material and to create a convenient means of communication between instructors and students. It provides many of the enhancements missing in the World Wide Web implementation of hypertext.
Previous papers [6,7] have analyzed student use and response to these tools.

2. ReCourse: the Student Perspective

ReCourse requires the student to login with a username and password. (Students who just want to see the pages, and don't plan on using the tools can bypass this login.) Once entered, the student sees the course web pages and icons representing the tools. Although the instructor can turn off any of the tools, the available tools are: *Add New User*, *Home Page Link*, *Chat Room*, *Search Tool*, *Grade Access*, *Site Map*, *Bulletin Board*, *Quiz Tool*, *Password Tool*, and *Help.* For further details on these tools, see [5].

3. ReCourse: the Instructor Perspective

We characterize faculty characteristics below:

Faculty Status (!) When the ReCourse team (students) sent an email invitation to faculty, inviting them to try out and then use the system, there was virtually zero response. When the author (faculty) sent the same message, many people responded.

Faculty Chaos & Inertia Of the faculty who did respond and declined to use the system, no one had time to even look at it. All mentioned wanting to use it "in the future." All appeared overworked - one mentioned being overwhelmed that term

Missing functionality One faculty used it for one term and did not choose to use it again. One of these wanted a feature not yet available (the grading system does not operate with full spreadsheet features yet).

No instructor help One factor is that some instructors have no teaching assistants to help them.

Unknown One other faculty member responded to our request, said he would like to use it, but, even with urging and help from the ReCourse team, failed to use the tools.

3. Author Characteristics

Although we continue to gather information and statistics, we know the following:

- The more computer literate an instructor/author is, the more apt they are to use the system, and the more apt they are to use more of the available tools.
- The more helpful the assigned ReCourse team member is, the more apt the author/instructor is to use the tool in its entirety.
- Newer faculty are much more apt to respond to the invitation, to use more of the tools, and to return to use it again. This is due to more experienced instructors having (existing, but not as appropriate) tools they are used to using and the general chaos that surrounds faculty members as they find themselves with more service activities. The ReCourse team believes as they hear that the tool is an asset, they will make the (small) effort to use it.

4. Conclusions

Using the Web to enhance or as the sole medium for teaching has produced a new range of problems and opportunities. Tools that facilitate such teaching are appearing and enhancing the delivery and activities of these courses. Studies have been made on how readers (usually students) use such material and tools. Systems have been developed that analyze the student profile, adapting both the pages and the navigation. Tools such as chat rooms, bulletin boards, cooperative learning techniques have all been designed, implemented, used, and studied from the student perspective. This paper explored the other side of these issues: the perspective from the author (usually an instructor).

ReCourse, the Retargetable Course Generation system, has had the instructor as a focus from inception. We reported on what we have discovered, what we have done as a result of these studies, and how these changes have improved and will continue to improve the system for students as well.

ReCourse is documentably popular and useful for web courses. Students like it. But students have grown up in a computer world and, now, even in a web world. Instructor/authors have more inertia. We are continuing to gather statistics from both the users and non-users in an attempt to encourage use of a system which improves the delivery of web courses.

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Video Case methodology for Facilitating Technology Integration into Teacher Education.

Debra Kurth
Center for Technology in Learning and Teaching
Iowa State University, USA,
dkurth@iastate.edu

Background

Teacher education programs are a catalyst for producing quality educators for the preK-12 environments. It is through the classroom experiences and the guidance of teacher educators that can assist preservice teachers in the formulation of their philosophical beliefs regarding teaching and learning (Harrington, 1993). New teachers are quickly confronted with many classroom and administrative demands which requires them to have a firm grasp on their philosophical beliefs so that they can handle educational issues effectively. Technology is an increasingly important issue for preK-12 schools and has the potential to have immense impact on the learning and teaching environments. Because of the expedient growth in technology, it is critical for educators to be cognizant of technological uses, impacts, and creative integrative strategies.

Teacher educators in higher education are finding themselves inadequately prepared for technological uses, let alone having the capacity to integrate it as part of the curriculum (Panel on Educational Technology, 1997). Many agree that integrating technology into the curriculum is very consequential and vital to the survival of our educational institutions, yet it continues to be insufficient for many (OTA, 1996). Fortunately, there are quality institutions implementing innovative ways to use technology. No longer are just televisions and VCRs being used, but various technologies are surfacing in higher education learning environments creating rich and fertile grounds from which students and educators are constructing and building knowledge collaboratively (Thomas & Boysen, 1984). Using technology to transform classrooms evolves into changing the philosophy of the schools, and ultimately the overall view of education (Sheingold, 1991). Thomas & Boysen (1984) contend that in utilizing computers in the most meaningful capacity, there is the potential to create a context in which students are learning to educate themselves through the use of computers.

Objective/Purpose/Project Description

Since teacher educators are receiving insufficient exposure to learning technological uses, preservice teachers are denied learning opportunities, which ultimately impacts preK-12 education. There are periodic workshops offered for teacher educators in higher education, but they lack the situational learning that is needed so that they can adapt and transfer learning to their own environment. The poignant question that now stares at us is: What can be done to provide concrete examples and promote situational learning on the uses and integration techniques of technology for higher educators?

It is our contention that the construction of knowledge through the use of technology may be the most feasible, meaningful, and integrative method in which to learn methods of technology integration in the classroom. Educators need and desire concrete examples of what technology integration looks like and how it affects learning.

A research team at Iowa State University in the College of Education in the Center for Technology in Learning and Teaching (CTLT) has begun to address this problem. This research team has designed a multimedia program with video case studies on CD-ROM format that models exemplary uses of technology in various learning environments. The purpose of this study is to design, develop, evaluate, and implement this program in a learning environment for teacher educators to provide them with rich examples of how technology can fertilize, stimulate, and flourish a learning environment.

The video cases will be used as an anchor in the learning environment to provide a situation where the learners share a common experience (Hasselbring, 1996). Within this shared experience among the participants, the learners will collaboratively build knowledge by pulling from past experiences and merging that with new information received from the video cases. This approach of using the conceptual anchor in the form of video can produce a common frame of reference better than any verbal explanation (Blackhurst; Morse, 1996). The video captures a rich and flavorful environment from which the participants can see the emotion, energy, and body language (from both students and the educator) which prospers in a learning environment interwoven with technology.

Procedure

During Phase one, teacher educators were video taped in the College of Education who demonstrated exemplary technology uses in their teaching methods. These tapings were then viewed, edited, and constructed into video vignettes through the use of Adobe Premiere. The clips for the vignettes were carefully chosen in order to provide the richest examples that would be meaningful for the audience. A portion of the spectrum of video examples obtained include a math class using the Iowa Communications Network (ICN), a language arts class using Powerbooks, a math class using the Jasper series, and a special education class using the Discourse groupware system. Through utilizing a variety of content areas, we will be able to more adequately reach the diversity of the end-user.

The design and development occurred during Phase two and was formulated simultaneously with the video editing portion of the project. Many hours were spent within the participatory design team to create the most suitable interface for the end user. Drawings were initially compiled so that the group had a conceptual idea of the overall look of the program and navigation abilities that would be provided for the user. An initial pilot program was created to obtain expert appraisal and end-user feedback from Iowa State faculty and audience participants in various conferences. Suggestions were taken back to the participatory design team and revisions were made. As this project is continually under revision as we add new video cases and involve more end-users, this feedback is critical to the continual design and development of our final program.

The template for the interface of the multimedia program was developed in Adobe Photoshop and Authorware was used as the authoring tool. The multimedia program is constructed in such a way that each participant can navigate according to his/her interests and have the opportunity to experience realistic examples of technology integration and begin to reflect and construct knowledge for their personal usefulness.

Our intention for Phase 3 is to formulate a workshop for higher educators where the video cases, accessed through the multimedia program, are used as the anchor for instruction. The combination of group discussions, individual navigation within the multimedia program, and individual and group reflections will contribute to the ability of the participants to transfer newly acquired knowledge to their present situation. Rather than just using their imagination, educators will have the ability to obtain a realistic picture of what a learner-centered, technology rich environment looks like.

Data Collection

Research members will conduct detailed observations as participants interact with the program, noting reactions, comments, interest level, and the time spent navigating through the program. In addition, a follow up interview will be completed to determine if any of the perceptions and uses of technology of the participants have changed.

Preliminary Conclusions

The utilization of this video case multimedia product will not address all of the problems that staff development sustains for teacher educators in higher education. However, the modeling of learner-centered technology-rich environments will procure the missing element that many training situations desperately crave. This type of learning environment allows the educators to gain the knowledge needed to integrate technology, but is presented in such a way that each learner can construct how technology utilization can fit into his/her particular classroom. Through the rich examples of various technology uses, the learning environment becomes more meaningful and realistic for the teacher educator. This collaborative effort of viewing the videos, reflection, problem-solving, and construction of meaning will reinforce that the technologies used can improve the learning and transfer of knowledge to the participants classroom environment.

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The Virtual Cell: An Interactive, Virtual Environment for Cell Biology

Alan R White[1] Phillip E. McClean[2] and Brian M. Slator[3]
Departments of Botany/Biology[1], Plant Science[2], and Computer Science[3]
North Dakota State University, Fargo, ND 58105 USA
alwhite@plains.nodak.edu; mcclean@beangenes.cws.ndsu.nodak.edu; slator@badlands.nodak.edu

Introduction: Learning by Doing

The Virtual Cell is being developed by the NDSU World Wide Web Instructional Committee (WWWIC), a multi-disciplinary group of faculty engaged in the development of virtual/visual worlds for science education (Slator et al. 1999). Other WWWIC projects include The Geology Explorer, The Visual Computer Program and ProgrammingLand MOO. Each of these projects share a common objective: to teach scientific problem-solving skills (deductive reasoning, experimental design, hypothesis formation) through immersion in learn-by-doing virtual environments. These projects are designed to support discovery-based learning in a self-paced, role-based, and goal-oriented framework. They are also learner oriented, immersive, and exploratory in nature. Each project aims toward highly interactive, highly graphical systems employing software tutors to guide and remediate in the event of student failure. In addition, each project individually pursues the objective of teaching discipline-specific science content through the achievement of authentic problem-solving goals, but using uniquely different approaches. The projects are designed to employ consistent elements across disciplines and, as a consequence, foster the sharing of development plans and development tools. More information about WWWIC and related projects is available at http://www.ndsu.nodak.edu/wwwic/.

One goal of post-secondary science education is to train future scientists. One problem with science education is the standard lecture/laboratory format. In lecture, the professor speaks, and the student passively listens. In the worst case, lectures are no better for learning than television: a totally passive, non-interactive experience. Meanwhile, laboratories are intended to afford students with an interactive, experimental experience, but in reality these are usually rigidly structured by the laboratory outline where the intended outcome is known and the procedure is inflexible. These are not experimental experiences. If laboratories were to be truly experimental, question- and hypothesis-driven experiences, then students would need access to modern laboratory equipment and instrumentation, an array of expensive laboratory reagents, and a wealth of instructor time that the university cannot possibly afford. Active learning can be expensive, yet the value of active versus passive learning has become increasingly clear (Reid, 1994).

The Virtual Cell

The Virtual Cell is a virtual, multi-user space where students "fly" around and practice being cell biologists in a role-based, goal-oriented environment. The Virtual Cell development project can be visited at http://www.ndsu.nodak.edu/instruct/mcclean/vc/. Working individually, or with others, students learn fundamental concepts of cell biology and strategies for deductive problem solving through their experiences in the exploratory environment, where they can make observations, manipulate the interactive objects, and design and perform experiments. This pedagogical approach gives students an authentic experience that includes elements of practical, experimental design and decision making, while introducing them to discipline content. By practical applications of the scientific method, students learn how to think, act, and react as cell biologists (Slator and Chaput, 1996).

The Virtual Cell is populated with subcellular components: nucleus, endoplasmic reticulum, Golgi apparatus, mitochondria, chloroplast and vacuoles. Each structure is rendered as a 3D object using the Virtual Reality Modeling Language (VRML), a computer language for specifying three-dimensional worlds that can be displayed and, most importantly, interacted with via the Internet. The Virtual Cell consists of a VRML-based laboratory and a cell. In the laboratory, the learner receives a specific assignment (learners are always assigned motivating goals in our learning-by-doing environments), performs simple experiments, and learns the basic physical and chemical features of the cell and its components. The virtual laboratory procedures require a voyage into a VRML cell, where experimental science meets virtual reality. The learner is supplied with a toolbox of measuring devices that assay various cellular processes. These tools include an O_2 meter, CO_2 meter, pH meter, sugar assay, protein assay, various stains, and enzyme assays. As the students progress, they revisit the laboratory, bring cellular samples back for experimentation, and subsequently receive more assignments.

The virtual cell contains 3D representations of all the components and organelles of a cell (nucleus, mitochondria, chloroplasts, etc). The user "flies" among these organelles and uses virtual instruments to conduct experiments. All navigation is learner directed; there is no predetermined exploratory path. This feature empowers the student to direct their own learning. The student is also able to travel into linked VRML worlds that represent the interior of each of the cellular organelles. Further experimentation inside each organelle allows the student to learn about their specific functions. For example, the learner may confront the nucleus and perform several simple experiments via touch sensitive points. The nucleus is not consuming or generating O_2 or CO_2 and it has a positive DNA Synthesis assay. Putting this and information from additional experiments together, the learner should deduce that the object is the nucleus and that DNA is contained there. Additional pertinent data about the nucleus and other cellular organelles can be collected in the same manner.

More advanced levels of the Virtual Cell include the introduction of cellular perturbations and the investigation of the functions of various cellular structures or processes. In the second level, a simulation will change the cell by either introducing a mutation or adding an inhibitor that disrupts a cellular process. An alarm will sound, some cellular process will malfunction, and the learner will be given the goal of diagnosing the problem. Using the same tools as in the previous level, the learner will navigate through the cell, make observations, and perform measurements and experiments. The learner will attempt to identify the affected area, the perturbed process, and the nature of the mutation or inhibitor that is causing the problem. As a result, the user will learn details of cellular processes and functions and become familiar with the importance of various mutations and inhibitors for cell biology experimentation. In the third level of the Virtual Cell, the learner will be given a set of goals to investigate a specific cellular structure or process. The learner will have at their disposal the tools from the first level and the mutations and inhibitors from the second level. Using these in various combinations, the student will form hypotheses, design experiments, and employ the toolbox items to perform these experiments.

The implementation of the Virtual Cell depends on coordinating three technologies: 1) VRML visualization, 2) a text-based MOO server (Curtis, 1992), and 3) Java client and simulation software. Students use a standard WWW browser to launch a Java applet, which provides a connection to an object-oriented, multi-user domain (a MOO; see below) where cellular processes are simulated and multi-user viewpoints are synchronized. The Java applet also launches an interface to the VRML representation of the Virtual Cell, allowing the student to explore and experiment within the 3D representation. The object-oriented multi-user domain (MOO) simulation on which the cell is established allows students to interact directly with one another within the cell, providing advice to one another or even working together to achieve particular goals. Because the MOO is internet-based, students from separate and distant locations can simultaneously interact with the cell and with one another. Unintrusive but proactive software agents act as tutors, monitoring students' actions and "visiting" the students as the need arises. Tutor agents provide advice on equipment choices, navigation, and scientific conclusions. Tutors neither mandate or insist on student actions nor do they block or prevent student actions.

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Global Perspectives in the Political Science Classroom

Margaret E. Martín, Dept. of Political Science, St. Thomas University, USA memartin1@stthomas.edu

In attempting to get my students to engage with the actual conditions of the countries we study in an introductory comparative politics course, I have created assignments based around exchanges between my students (mostly from the US, 18-23 years old) and students in our case countries. The exchanges took place over in 3 different ways with different levels of instructor participation. The first exchange was between myself, my Comparative Political regimes class and Professor Nicolai Petrov who was teaching at Novgorod State University in Russia and his Political Philosophy class. The second exchange was a one to one "keypal" match between my comparative students and individual students from an ESL class in the Ukraine and the third exchange took place between my students and an introductory class in Foreign Affairs taught by Greg Poelzer at the University of Northern British Columbia, Canada.

The Carleton-Novgarod Exchange

I responded to a post on the Political Science Teaching e-mail list from Professor Nicolai Petro from the University of Rhode Island who was on a Fulbright Teaching fellowship at Novgarod State University in Russia. We arranged a class to class exchange where students composed questions as groups, which he translated from English into Russian. The result was a series of interesting question and answers between the students, which I posted onto our web site along with additional material about the class, and pictures of the students. Nicolai Petro sent me scanned images of his students and I put them up on our site. The exchange fit well into our week on Political Culture since I asked the students, not only to think of questions but also to reflect on the Novgarod students' responses in their "lab assignment." The exchange that we undertook with the Novgarod students was a fairly static affair, due to the constraints on the situation (the fact that the Novgarod students didn't have individual access to the internet and the need for translation.) Nevertheless, the students enjoyed the interaction and I was even able to use the assignment as a learning tool the following term when I had my students evaluate the exchange, focusing on the questions that were asked, how they were answered and if there were noticeable differences in political culture. The students found that there were. There were also interesting differences in the way my students perceived what was going on in Russia versus what the students perceptions were, living there. A great deal of attention was given to Ultra-Nationalist figure Vladimir Zhirinovsky in the US, compared to his actual draw at the polls in the 1996 elections. The Russian students felt that Zhirinovsky was "stupid" and "comical" and said they were not surprised that he lost the elections. The Russian students also looked at the effect of the economic crisis from their own perspective, they commented on how their instructors were not receiving their paychecks regularly and the students were not getting their stipends either.

The Carleton-Ukraine Exchange

After this positive experience with an exchange I began to search out other opportunities for exchanges. A matching service at by St. Olaf College (http://www.stolaf.edu/network/iecc/) for teachers and students seeking "keypals" (matching students with e-mail addresses for direct correspondence) although the process of identifying and setting up potential exchanges proved to be a frustrating process with this method. The main reason I discovered was that most of those interested in exchanges were high school classes, which were not at my students' level or ESL classes. I was eventually successful in establishing a "keypal" link up with an ESL class at the Technological University of Podillia in Khmelnitskiy, Ukraine. I developed some simple questions that the students could ask about living under economic reform in the Ukraine.

Although two of my students reported positive and interesting interactions with the Ukrainian students, the rest of my students complained that they had been disappointed with the assignment on a number of counts. Students that initiated the contacts late discovered that some of the Ukrainian students only seemed to check their e-mail about once a week. Some never seemed to check their e-mail at all. When I questioned the teachers about this, they replied that a few students had been "sick" a great deal or that they really had no idea what the problem was with the student. Such low accountability led to an imbalance in the exchange and except for the two aforementioned students, the exchange was not a success. The University of Podillia also apparently experienced a massive failure with their external internet connection late in the term which further complicated the exchange. In principle, an ESL class could have worked, however, ESL teachers are notoriously overworked and underpaid nearly everywhere in the world, it seems and thus, the amount of effort that teachers can devote to such a project is limited. Of the two students who did exchange e-mail with the Ukrainians, it must be said that the exchanges were extraordinarily beneficial. One student was puzzled that her keypal didn't seem to be suffering much from the Economic situation. After several exchanges, my student learned that this woman's parents were both business people in the new capitalist economy, and were relatively successful. From this, my student learned that in the economic reform in the former Soviet Union, some people are doing better, even though many are doing a lot worse in the immediate context and that experiences are likely to be different across society. The other student who was successful found common ground with his partner in that both came from families who had struggled. My student was from an Hispanic neighborhood in east Los Angeles and had come to Carleton on a Scholarship.

The Carleton- UNBC Exchange

This last exchange was probably the most effective in terms of the quality and quantity of information traded back and forth. I put my request for an exchange on the political science research and teaching list that I had discovered Nicolai Petro's request on and received a response from a Canadian political scientist, Greg Poelzer who had been forwarded my request by a colleague. Greg took the initiative to set up a simple, threaded web based forum in which both of our classes could input questions and responses on topics that he put up. We put up political culture and the Quebec issue on the board and both got interesting responses. My students were perplexed to learn that the British Columbia based students could care less about Quebec separatism and were more interested in issues involving their own province, such as Native rights. From this they learned about Canadian Federalism, as a cultural and institutional separateness that already exists in Canada, quite apart from Quebec's bid to be sovereign.

Some Concluding Remarks and Suggestions

Not all courses benefit from this kind of exchange, but such interactions can be extremely worthwhile. The role of the instructor is transformed to some extent. I am less of a gatekeeper and more like a guide. Although I still present the student with information selected and "pre-packaged" by me, with these exchanges they are also faced with "raw data" (comments from their "keypals" or classes in other countries) that they must attempt to evaluate. The three different formats for exchanges provided acceptable communication conduits, although it was clear that the human component had to be committed to insuring a quality exchange. Exchanges with other political science classes worked better since the students were already primed for discussing political science topics. If greater attention were given to creating specific types of discussion exchanges in higher education, higher quality exchanges involving complex topics and cross-cultural themes could result. There are a number of ways that the potential for the internet media exchanges could be realized: These types of exchanges could benefit students at various types of institutions and could be tailored to fit the needs of both a small liberal arts college environment like Carleton, or a large university setting. Small liberal arts colleges focus on the character building, rather than training in a specific discipline. Exchanges could allow the liberal arts student to gain knowledge from external perspectives. The large university student who typically has less means and opportunity to travel abroad for enrichment can learn much from a discussion with individuals in other countries that could be put to use later professionally in the increasingly global work environment. Exchanges based around an event might also prove to an excellent way to mobilize teachers for multi-lateral exchanges. Disciplinary Academic Organizations could attempt to foster classroom exchanges using inter-institutional contacts that they already have. This would help them fulfill one of their roles as a bridge between the classroom and the research environment, which all too often remain distant from each other in higher education.

Creating a Global, Interdisciplinary Classroom

Cary Staples
Associate Professor, Art
University of Tennessee
staples@utk.edu

Russel Hirst
Associate Professor, English
University of Tennessee
rkh@utk.edu

By way of a grant and a summer workshop on information technologies sponsored by the Innovative Technologies Center at the University of Tennessee, Knoxville, we (Cary Staples, Art; Russel Hirst, English) have created a class that we call "Verbal + Non.Verbal Communication." It began in January and ends in May, 1999. The students are Graphic Design majors and English majors--about half and half.

The purpose of the class is to provide students with a highly collaborative and technologically enhanced classroom setting wherein they can learn how to combine textual and visual elements for effective communication in business and industry. A special concern is that communications be as "global" as possible--that is, easily understood by, or easily translatable to, other cultures and countries.

We have approached this rather ambitious goal by way of three phases. In the first phase, the English majors learned something about the technological tools at their disposal (Quark Express, PhotoShop, etc.) and about basic principles of visual design. Design majors got some review on principles of mechanics and style. Both sets of majors were encouraged to draw upon each other's expertise in the months ahead. In the first assignment, writer/designer teams created business cards--at this point, with no particular attention to international communication.

Phase two saw us ushering in the international theme by way of an exercise that required students to "create a new country" by merging the characteristics of two real countries. The idea was to define and advertise the new country so as to attract tourism. Some students chose to create web sites to satisfy the assignment; others produced hard copy. Students created countries such as "The Enlightened People's Republic" (Egypt and India) and "Taiwon-on" (pronounced "tie one on," a country born of a combination of characteristics evidently inspired by Taiwon and Lebanon--a haven for those who love to party). We asked students to critique each other's productions as we ourselves were doing for them. At the same time, we began to ask our students for contributions to the class web site. For example, each student was asked to submit three annotated URLs of sites that they consider valuable for communicators.

Phase three has focused on documents for business and industry. The first assignment in this phase was to create a set of instructions. Some students produced instructions with direct business/industry application, but others were quite playful, coming up with instructions such as "how to juggle," "how to put on a pair of pants," and "how to avoid conversion into fanatical religious organizations."

Our final assignment, however, has left no room for anything but direct application to business and industry on an international level. Though our original idea was to have students work as writer/designer teams to develop a series of warning labels and instructions, we actually have them doing something even more sophisticated than this: they are, in their hypothetical roles as industry consultants or in-house technical communication managers and designers, creating policy-defining handbooks or web sites that *show fellow communicators* how best to write and design warning labels and instructions for their company's products. This exercise requires them to define company communication goals and policies and to create individual warning labels and instruction "posters" by way of illustration. Their concerns are to communicate clearly, to create the best possible marriage of text and graphics, to communicate so as to avoid/reduce legal difficulties, and to be culturally sensitive and intelligent. They must also coach their fellow communicators about how to create warnings and instructions that will avoid or reduce litigation for their companies. We invited a colleague who has doctorates in both linguistics and law to speak with our students on this theme.

This current, and last, assignment involves much research into international communication. Once again, we have asked students to share their research with their colleagues. For example: each student has sent us information about a particular country or culture that could help communicators to communicate well in that country or culture. This involves information about politics, race, history, gender issues, etc. as well as special meanings of color, gestures, symbols, and so on. All this information has gone onto the class web page for use by all the students.

Our next guest speaker, the president of a company that makes warnings labels for international companies, will provide an important "reality check" to students--though we have deliberately delayed his arrival until late in the semester lest the creativity of students be curtailed in any degree! Students will get feedback on their work not only from our speakers and from us and from their fellow students, but from professionals abroad. These professionals will use our class web site to evaluate our students' work. This evaluation by internationals will be very important, since students need to know whether their products really do communicate effectively to a variety of cultures.

Each student team will compose a "brief" for these international reviewers--that is, an explanation about what they are trying to accomplish in their communication. However, the reviewers will post their initial reaction to the work generated by the students *before* they have access to the briefs. Later, after reading the briefs, the reviewers will be able to post additional comments. Students can then make modifications based on both sets of feedback.

Our hope is to initiate an ongoing dialogue between educational institutions and industries in developing clear, understandable warnings, instructions, and other documents. We want to teach our next course to students at a number of universities via distance learning technologies. The hope is that the later classes will provide a more diverse pool of images and terminology and will allow the discussion to progress further.

To summarize--our class has several purposes:

• To offer insight into the complexity of global communication problems.

• To allow students to work in multi-disciplinary teams without head-to-head competition.

• To create an a technologically enhanced, non-traditional classroom.

• To experiment with, and review, communication efforts.

• To create an environment that will live beyond the framework of a traditional semester and become an ongoing resource for education and industry.

Previous classes that used a web site as a class outline, and that used student research to complete the site, have been very successful. This is our first attempt to create a site that is both cross disciplinary and international. We have been helped tremendously in the creation of this site by the superb staff of UTK's SunSITE (http://www.sunsite.utk.edu). The website we've created in collaboration with them is at http://sunsite.utk.edu/neighborhoods/verbal.

During our presentation, we will give you a tour of our web site and display and discuss examples of student work and feedback they received.

Designing in a Structured World: Instructional Design and Course Development within an SGML/Structured Information Environment—The Open School Experience

Solvig Norman
Course Development, Open School, Open Learning Agency
Canada
snorman@opcnschool.bc.ca

Michelle Nicholson
Course Development, Open School, Open Learning Agency
Canada
mnichols@openschool.bc.ca

The Context

Open School, a service of the Open Learning Agency, develops Kindergarten to Grade 12 distance education courses and resources for approximately 48,000 students located throughout British Columbia and Canada. These courses have traditionally been print-based, supplemented with some additional media (e.g., audio, video), and delivered to students via the postal service. More recently, however, Open School has been attempting to develop a new distributed learning environment which would allow for more flexible design and distribution of course materials to meet the various and ever expanding needs of our learners. Features of this new environment include a learner-centred approach to development of materials, electronic communications between students and instructors, a modular course development process based on structured information, choice and flexibility of different delivery formats, a resource-rich environment for students, different media being used in parallel, and synchronous and asynchronous interaction between students and instructors.

Using SGML as an Underlying Framework

The framework underlying Open School's new distributed learning environment is a technology called SGML (Standard Generalized Mark-up Language). SGML is an international standard (ISO 8879) published in 1986 and has been used extensively for producing documentation within high technology and publishing industries. It is an approach used in the design and creation of documents where the focus is on specifying a standardized approach to identifying the components of a document and how they relate to each other. Documents are independent of any specific hardware or software, so exchange of files between users who have different SGML systems is quite seamless. SGML allows for the separation of a document into three layers: structure, content, and style—but deals mainly with the relationship between structure and content. Structure, which is at the core of SGML, is embodied in the Document Type Definition or DTD. Content is the information itself such as titles, paragraphs, lists, tables, graphics, and audio. SGML does not try to store information about the way a document looks— instead it tries to describe a document according to its content (Arbortext 1999). The separation of structure and content of a document from the appearance or style, enables a variety of instructional media to be produced using the same source material; for example one can simultaneously produce a print instance with italicized words and an on-line version of the same content with hypertext link to a glossary.

SGML was selected as the foundational framework for Open School's new distributed learning environment because it can effectively:

- provide a structured approach to the development of course materials,
- enable an easy customization of courses for different student needs,

- facilitate the re-purposing of content,
- provide flexibility beyond print-based publishing (e.g., multiple formats—such as print, WWW, CD ROM).

The intent is that all of these features will help support the development and sustainability of the Open School distributed learning environment.

Instructional Design within a Structured Information Framework

Instructional design is an eclectic integration of principles and procedures from many theoretical fields historically based on hard sciences and social sciences. At the heart of it, however, is the design and development of learning experiences to support learners' success. Open School's instructional design process, as based on structured information and SGML, consists of four main stages of development; Stage 1 learning outcomes/content outline, Stage 2 resources, Stage 3 activities/assessment, and Stage 4 authored course [see Figure 1]. The first three stages of Open School's development process represents core features of instructional design which include extensive planning based on learning outcomes and learner profiles (Stage 1). The result of Stages 1 to 3 is a very structured and detailed plan for Stage 4 that comprises of a fully written and fleshed out course. This process allows for detailed planning of content to be delivered using different media (e.g., print and the Web) while allowing for flexibility and customization in order to the needs of the learners.

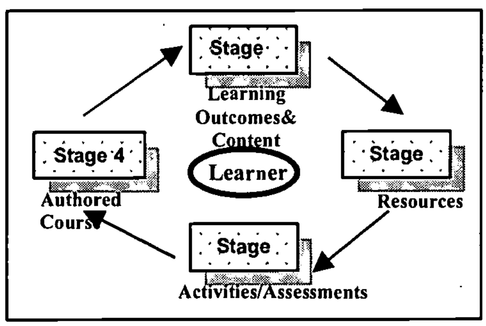

Figure 1. Open School's Development Process

The implementation of a structured framework based on SGML has prompted a closer examination of instructional design and specifically instructional design plans (e.g., Stages 1 to 3). The implementation of a structured framework has explicitly enforced a consistent way of describing learner profiles, learning outcomes, creating subject/topic associations, suggesting instructional strategies, and assessment strategies (e.g., via instructional design document type definition—DTDs). Structure within varies courses is consistent, but the content will vary depending on the outcomes and subject matter. Each instructional design plan becomes a foundation for all subsequent development. Learning outcomes, content, activities, assessment, and resources are attached directly to the plan, incrementally growing the resulting document set. A "course" ultimately becomes the complete set of documents surrounding a given instructional design plan. The result is a manageable base of course materials. This entire process is still in a prototype stage within Open School. The test bed for implementing SGML is presently on going with the development of thirteen high school level courses within the structured information model. These thirteen courses will be delivered entirely in print and on the Web in the near future.

Reference

Arbotext (1999) Web site
www.arbortext.com/Think_Tank/SGML_Resources/Getting_Started_with_SGML/getting_started_with_sgml.html

Teaching Data Communications Concepts in a Practical Way

Vishwa N.Shukla
Computing Systems and Technology, Department of Business
Auckland Institute of Technology, Auckland, New Zealand

Ken Surendran,
Department of Information Systems and Computing
UNITEC Institute of Technology, Auckland, New Zealand

Background:

In Polytechnic curriculum, equal emphasis is placed on both practical and conceptual aspects of a subject. With regard to the conceptual aspects, better results are realised when practical demonstrations are used in the facilitation process. This paper illustrates the use of several simple gadgets in the classroom to help the students of Business Computing (National Diploma in Business Computing) get a better feel for complexities of the modern-day computer data communications. The students in this group have no engineering background, even though they have been exposed to the basic layers of OSI model, the operation of asynchronous communication link, use Linux for networking, and an overview of network management. Without the understanding of the *engineering aspects* of data communications and networks, these students are handicapped in appreciating the complexities of modern computer networks using Fibre Distributed Data Interface, Asynchronous Transfer Mode, etc.. Further, they fail to get *a feel* for the benefits - such as higher signal-to-noise ratio, larger bandwidth, low channel noise, data transportation at a constant rate, etc. – offered by these multi-service wide-band networks.

Possible Facilitation Enhancements:

Normally, analytical models and theoretical explanations are used as part of the facilitation process, when dealing with such topics. However, such techniques are not very appealing to the students who have no exposure to the Communication Theory and as such they soon lose interest and motivation. In some institutions with on-going engineering curriculum, one might consider a visit to the communications engineering lab., where some of these expensive high technology equipment and tools are available. However, the authors do not have access to such facilities and hence have resorted to the use of simple commonly available electronic gadgets to demonstrate these concepts. In the following, an illustration is provided which uses a Laser Pointer (used with Over Head Projections), a couple of AM/FM radios, Headphones and a Light Dependent Resistor (LDR) coupled to a pre-amplifier.

The schematic in Fig.1 shows the actual arrangement of these gadgets for demonstrating some of the key concepts in Data Communications. As pointed out earlier, the objective of the Data Communications Demonstrator (DCD) is to provide *a feel* for the following practical aspects relating to Data Communications:

- Laser beam as a *data carrier*
- Wireless *point-to-point* communication
- Modulation/demodulation of a *carrier* using a *signal*
- *Noise pick-up* by the communication channel and *signal-to-noise ratio*
- The effect of *bandwidth* limitation.

Referring to Fig. 1, the headphones with a flat polished metallic diaphragm work as a reflector for the laser beam. (The front side of one earpiece of a common stereo headphones is chopped-off, to expose the metallic diaphragm.) The Laser Pointer is positioned in such a way, that the narrow light beam is reflected (at about 90 deg.) from the exposed diaphragm of earpiece. The headphones' jack is connected to one of the AM/FM radios, and the radio tuned to a FM channel playing music. The musical note causes the diaphragm to vibrate and thus *Amplitude Modulate* the reflected Laser beam. The LDR, functioning as a *demodulator,* reproduces the electrical signal corresponding to the original audio signal. This received signal is processed through a preamplifier to prevent the loading of demodulator

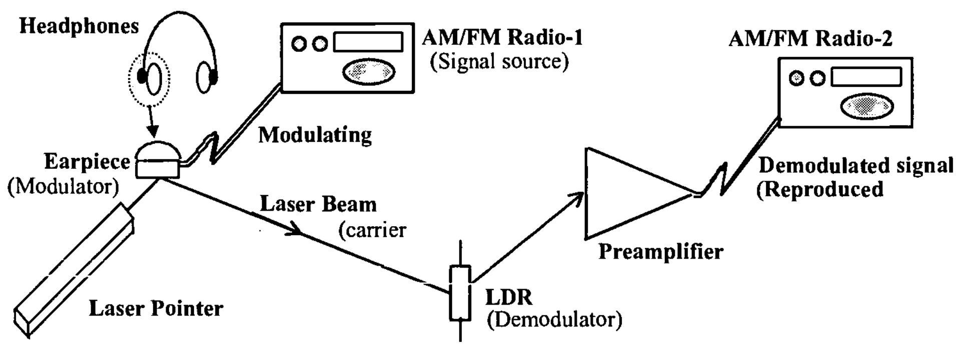

Fig. - 1, Schematic of the Data Communication Demonstrator

and fed to the audio section of the second AM/FM radio for reproducing the musical notes. The circuit schematic of the pre-amplifier is shown in Fig. 2. This is constructed with two LM324 type operational amplifiers with an overall voltage gain of 10. The power for this circuit is derived from the second AM/FM radio.

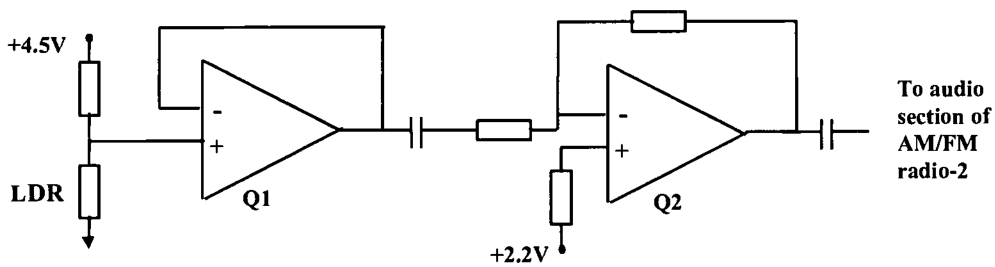

Fig. – 2, Circuit schematic of the Pre-amplifier

The following is a description of how the DCD setup is used to demonstrate the key practical aspects of computer data communication –

- A laser beam is used as a *data carrier*. At the headphones, the electrical signal (corresponding to the music) *modulates* the carrier. The LDR *demodulates* the carrier to extract back the signal.
- The data is transported with a *wireless* (light) link. As the light can not bend, the transmitter and receiver must have line of sight. This arrangement thus illustrates point-to-point communications.
- The florescent room lighting is a source of *noise* for this set up. For a fixed signal strength (i.e., keeping the music volume constant), switching off the room light improves the quality of music signal received. By varying the music volume (signal strength) the significance of *signal-to-noise ratio* is demonstrated.
- The *environmental noise pick-up* is demonstrated by moving a clear plastic film (even reading glasses) in the path of the laser beam. The minute scratches / impurities in the clear film produce a 'scratching' noise in the received audio signal.
- Displacing the laser beam away from the LDR has the effect of reduced *bandwidth*, which results in a poorer quality of the received signal.

Conclusion:

Following the practical demonstration using DCD, the data communication concepts were discussed in the class. After session, the participants were given a questionnaire to evaluate the usefulness of the demo. In their response, 80% of the students considered that the DCD demo had contributed significantly to their learning, compared to the theoretical discussion. Some even indicated that they would like to perform these experiments themselves. On the whole, 50% rated good (and 30% average) understanding of the data communications concepts contained in the DCD demo. Specifically, the aspect on wireless was appealing to about 80%, media / noise aspect to about 60%, modulation/demodulation to 50% and signal-to-noise ratio to only 30%.

Teaching Students about Online Facilitation: Hosting a Virtual Conference

Joanna C. Dunlap
School of Education
University of Colorado at Denver
U. S. A.
Joni_Dunlap@ceo.cudenver.edu

It is difficult to teach people to be good online courseware developers if they don't know what it is like to be on the receiving end of their designs -- either as a student or an instructor. In a graduate-level course on Designing Web-based Instruction for Distance Education, students are typically involved in a number of design and development projects, in which they function as instructional designers hired to build a Web-based lesson, module, or course for a distance learning audience. In the past, students would excel in (1) Web site and page layout and functionality and (2) the distribution of content and activity/project descriptions, but would fail to address issues of social interaction, student collaboration, student motivation to return to the Web site over and over, etc. In fact, it was difficult for them to understand why focusing on Web teaching and learning strategies was necessary for them in their roles as "WBI designers". Unfortunately, the class did not have access to pre-existing Web-based courses that they could be required to facilitate in order to gain experience in Web teaching and learning. Therefore, students are required to host a virtual conference. By hosting the virtual conference, students are exposed to the triumphs and frustrations of creating an interactive learning experience delivered via the Web.

Thus far, two Virtual Conferences have been hosted by two different groups of students: one in Fall 1997 and one in Fall 1998 (the 3rd Annual Virtual Conference will be held in Fall 1999). Comparing students' work prior to and after the Virtual Conference assignment revealed that WBI students/designers:

- moved from creating professional-looking "page turning" Web sites that simply delivered textual/graphical content to developing interactive, student-centered activities (such as games, case studies, and problem-based learning activities) for learners to work through; and
- utilized communication technologies differently: instead of simply posting discussion questions on an asynchronous threaded discussion forum for learners to respond to, both asynchronous and synchronous communication technologies (threaded discussions, reflective journals/forms, chat and whiteboard) were being used for debates, collaborative project/product development, peer teaching, and presentations.

The Virtual Conference assignment has been so effective as a learning experience for WBI designers/students -- as well as providing a good learning experience for the virtual conference participants -- that the Fall Virtual Conference is now an on-going staple of the Distance Education track of the Instructional Technology graduate program, with plans to host a virtual conference every Fall.

The Virtual Conference Assignment

For the Virtual Conference assignment, students collaboratively develop and deliver an online/virtual professional conference on various aspects of designing distance education for the WWW. Besides the actual conference, documentation (1) describing the strategies and tactics used to promote, organize, facilitate, evaluate, etc. the conference and (2) supporting the design decisions made based on front-end analysis data is required. Results of the conference are debriefed in class, and students are required to reflect on the overall experience and on what they learned from the process; their reflection was structured by an online assessment (see http://www.cudenver.edu/~jdunlap/5990/conferencejournal.htm) they helped to develop (see an example of a student's evaluation of the virtual conference experience at http://clem.mscd.edu/~woodleyx/wbi/online.htm).

Description of Student Activities

The objective of this project is for students to collaboratively develop and deliver an online/virtual professional conference covering issues related to designing distance education on the WWW. To make this happen students have to take responsibility for a number of activities and deliverables:

- As a class, students have to select five topics that represented important issues of Web-based distance education. They then have to determine who will be responsible for which topic/s. Responsibility for topics requires students to research, prepare (includes, but is not limited to, developing a Web-based presentation and/or paper), manage, and facilitate the portion of the virtual conference related to those topics. The conference runs for four days during each Fall semester; topics, activities, and facilitators have to be scheduled by the students for each day of the virtual conference.
- As a class, students have to decide what Web-based communication technologies are needed to conduct the online conference and create or contract those technologies.
- Students need to determine what strategies and tactics should be employed to ensure conference attendee participation throughout the duration of the conference. This includes lining up "guest speakers" and/or developing presentations, debates, case studies, and other engaging activities that will keep conference participants involved.
- Students also need to develop an evaluation tool so participants can let them know what they think. Students must analyze the evaluation findings to determine "lessons learned".
- Students develop and upload the conference site.
- Students promote the conference to classes, students, and faculty in the School of Education and any others deemed appropriate, and to outside educational and professional groups.
- Students are responsible for providing technical support throughout the conference.
- Students document in writing the decisions they make on the above issues.

1st and 2nd Annual Virtual Conferences: The Students' Conference Sites

There have been two virtual conferences hosted by graduate students in the Designing Web-based Instruction for Distance Education course:

1st Annual Virtual Conference: Instructional Strategies and Delivery Issues of Web-Based Instruction – http://carbon.cudenver.edu/~jdunlap/seminar/

2nd Annual Virtual Conference: Beyond Page Turning and Lecture Techniques: Effective Instructional Strategies for Web-based Learning Environments – http://web-education.net/fall98conf/

[**Note:** For notification of future Virtual Conferences, see http://ceo.cudenver.edu/~Joni_Dunlap/AACE/virtualexamples.html]

A Few Examples of Students' WBI Projects after Hosting a Virtual Conference

Web Design for K-12 Teachers -- http://carbon.cudenver.edu/~lbatzel/Web_Design/home.htm

Ethical Decision-making in Business -- http://clem.mscd.edu/~woodleyx/wbi/Content/ethics/index.htm

Introduction to the Internet -- http://carbon.cudenver.edu/~slancton/frame.html

Creating Geographic Cross Sections -- http://www.cudenver.edu/~abol/Cross_Section/home.html

Teaching with the Web: An On-Line Forum for K-12 Teachers - http://bvsd.k12.co.us/~mullerb/teaching/forum/

Case Studies in Research Ethics -- http://carbon.cudenver.edu/~mstephen/bioethics/homepage.html

Reusable Web Sites for Content Delivery

Roland Hübscher
Computer Science and Engineering
Auburn University
roland@eng.auburn.edu

Introduction

The rapid advancement of the World Wide Web and hypermedia systems puts educators more and more under pressure to provide some of their course material on the web. But given the time constraints of the faculty and the necessary skills in electronic media production, it cannot be expected that many useful systems will be built and used by them. Most available systems support a great deal of activity that goes into the development of an electronically enhanced course with features which support testing, interfacing with other university-based systems, tracking of students, assignments, chat rooms and some instruction. However, explicit support for the development of a web-based environment for learning is rare at best. One of the exceptions is an adaptive hypermedia system provide navigation support that adapts to the user's action and learning (Brusilowski et al., 1997). However, the provided navigation space tends to constrain the learner's possibilities for exploration.

Our system attempts to provide hypermedia sites that minimize such constraints on exploration, yet still providing a flexible site structure optimized for the used teaching method. A possibly radically different site structure is necessary to support various teaching methodologies. But who creates all the web pages for the courses and keeps them also up-to-date? And how do we make sure that the students exploring the site don't get lost and frustrated instead of learn from them?

Reuse and Exploration

Once a reasonable fraction of a course's content is put on the web, the site is rather difficult to adapt to new situations due to the static structure of web sites. Thus, the reusability of web sites is minimal. The organization of the pages, navigation support and links to related issues or prerequisites are static and optimized for this course's topic, time frame, emphasis, and the educator's teaching style. However, the course should be reusable in many different ways: when moving from the quarter system to the semester system; when the senior-level course is upgraded to a graduate-level course; when the focus of the course changes; or when a related course is designed. If a different faculty member teaches the same course it probably needs to be restructured due to a different teaching style and other preferences. Thus, providing the same course material for everybody and every situation is in general not feasible because it does not support what the educator and the students need. However, changing a web site to accommodate another teacher can cause a major reorganization of the web site, which, in general, is not feasible either. Current tools do not support reuse in any interesting way.

The second problem addressed by our approach is to provide a hypermedia system that provides a large exploration space. All those and only those paths that are consistent with the pedagogical method used by the educator should be available to the learner. The user is supported in selecting paths consistent with the pedagogical method by the organization of the site and by dynamic navigation support.

Our approach is based on the observation that the order in which content is taught depends on both, the content and the teaching methodology employed. Whereas most other tools have a "correct" teaching methodology built-in, our tool provides a simple mechanism to describe such methodologies.

The educator uses the tool as follows. First, she represents the content independent of what teaching methodology she will use. Then, the teaching methodology is formalized in such a way that it can be applied to any content resulting in an organization of this content supporting the selected teaching methodology. The content is represented in a semi-formal using concept maps. The claim that teaching methodologies can be formalized may come as a surprise. This paper will describe in some detail how we formalize those (only) parts of a teaching methodology relevant for the content organization. It is an empirical question whether the resulting web sites are indeed educationally well organized.

Content Description

The course content is described independent of how it will be organized in the web site, allowing the user to concentrate on content only. We have chosen a semi-formal representation that many educators are quite familiar with. We use a hierarchical concept map containing descriptions of content units like concepts, skills, activities, etc. and their relationships as a graph. The interface allows an incremental development of the content without having to deal with the constraints of the course and the teaching methodology employed. Furthermore, content units can also be assembled from other content units, i.e., content units range from a single idea to topics to courses and even to whole curricula. These units can be related to each other with relations like "*a* is prerequisite of *b*" or "*a* is part of *b*". We are using semantic zooming and fractal display techniques to deal with the potentially large concept maps (Furnas & Bedersen, 1995).

Description of Organization

The teaching methodology is represented in terms of rules that generate the temporal organization for the course content. There is more to a pedagogical methodology than ordering the content, however, organizing the content for a course can be viewed, slightly simplifying, as providing all the educationally appropriate sequences in which the course material may be traversed. Most often, when a faculty prepares a course, he or she chooses one of the many sequences that seem to be adequate.

Instead of providing a number of built-in methodologies, the user can describe a methodology reflecting her own teaching. This description can then be applied to any content. The methodologies are described with simple if-then rules. In a later phase, we will provide a more appropriate interface to the end user. Although we can only express the temporal relationships *before*, *after* and *during* we believe, based on some informal tests with a prototype, that we can describe a large part of interesting relationships for content organization. For instance, if a *x* and *y* are two concepts, then the rule "**if** *x* is a prerequisite of *y* **then** *x* is before *y*" says that prerequisites must be visited before what they are prerequisite for. Another rule could rule say that related issues should be visited parallel to the main topic "**if** *x* is strongly related to *y* **then** *x* is during *y*".

These rules transform the concepts into an and-or graph that can be traversed in any order that is consistent with the rules selected. This organization is then transformed into web site and navigation support in form of an applet makes sure that exactly those links are accessible consistent with the selected methodology. In this way we maximize the space the learner can effectively explore. For instance, given above rules, the student can look at a part-whole hierarchy moving from the whole to the parts.

Conclusions

A prototype is currently being implemented as a Java applet with a visual interface that can deal with large concept maps to describe the content. We have developed an efficient graph algorithm that accomplishes the guidance of the exploring student. Finally, the resulting organization is mapped to a web site. This part will take advantage of work on multimedia roles (Recker & Ram, 1994). Thus, the educator is required to deal with content and pedagogical issues, but not with HTML, CGI, and other details irrelevant for him.

Several important questions need to be answered empirically. First, can we represent large and complicated concept maps so that educators can use them effectively? Second and more central to the topic of this paper, can all interesting pedagogical methodologies be expressed with our simple, rule-based language? Third and most importantly, is the resulting organization of the content indeed supporting these methodologies?

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Bringing Students into the Community of Practice

Teresa Hübscher-Younger
Department of Computer Science and Engineering
Auburn University
United States
teresa@eng.auburn.edu

ResearchAid, an interactive, dynamic hypertext system, is being developed to help students become members of a working scientific research community. The system has students editing, creating and researching content using a Web browser. ResearchAid strives to make students become active members in a scientific research community through aiding the following activities: it helps make explicit and available the goals of a research community; it helps provide a structure for learning and using the communities' discourse and reasoning strategies; and it helps make explicit some of the distributed knowledge within that community.

ResearchAid started with the goal of having students learn to operate a complex machine, a meniscus coater, in a manufacturing environment from a computer system. However, a contextual inquiry into a manufacturing research environment at Georgia Institute of Technology found that the way students learn to operate the machine, a one-on-one apprenticeship with a graduate student, is entwined with their learning other practices in the research laboratory. Through this apprenticeship, students get to know other members of the research community and receive advice on different aspects of their project. Having these students learn how to operate the machinery from a computer tutorial system may prevent them from learning the other practices and especially from learning how the practices are related.

It was also realized during the contextual inquiry that what did need support was a different learning activity — the planning, running and reporting of independent research by undergraduate students. Undergraduate students were told that they would be doing independent research projects in the laboratory. However, they were not encouraged to design their own experiments. Instead, they were told roughly what they would be doing, given the procedures for collecting data and would run the experiment on their own. It was not until they were analyzing the data that they got a sense of what the design of the experiment they were running was. They were not trusted to design a relevant experiment for the community, because becoming a member of that community of practice is a long and difficult process for the undergraduate students.

To improve undergraduate students' learning experiences in research laboratories students need to develop the abilities that are required for taking a more active role in their research. As Scardamalia, Bereiter et al. emphasize, "Educationally irrelevant burdens, should be minimized, but not in ways that deprive students of occasions to develop the planning, monitoring, goal-setting, problem-solving and other higher-order abilities that are important objectives of education," (1989, p. 53). The practices seen in the research laboratory studied took away the students ability to participate in these higher-order objectives.

The computer can help develop communities of practice when it acts as a mediational technology, which "emphasizes the possibilities of using the computer not simply as an individual tool but as a medium through which individuals and groups can collaborate with others," (Bannon, 1995 , p. 272). ResearchAid acts as a resource and aid for collaborating students, but does not itself collaborate with students or create problems for the students to work on collaboratively.

The students in the research laboratory needed help in becoming a member of the research community more than they needed help with any particular machine. As Lave and Wenger (1991) have argued, becoming a member of a research community requires familiarity with its current goals, strategies and knowledge. Lack of familiarity with these goals, strategies and knowledge made it difficult for these students to take an active role in their research projects beyond the collections and analysis of data.

ResearchAid helps scaffold new students' participation in the manufacturing research community in the following ways:

- It presents prior research (experimental designs and reports), so that students can understand how it developed from the lab's goals and can use it as a model for creating new research. The application presents the research in the framework of research problems that have been or are being explored by the research community. This helps students formulate a problem they would like to explore that fits within the research community's goals.

- It helps students practice and understand the discourse strategies of the community by designing experiments in an environment which explains the elements of an experiment.
- It provides the means for members of the community to asynchronously communicate, monitor each others' progress and give feedback through adding commentary to the experimental design.
- It promotes students revising and refining of their initial experimental design and promotes reflection about alternatives to their design.
- It gives students a way to collect data on the flexible database accessible by the World Wide Web (WWW) and makes it available for analysis. This way others can research the data collected by students, examine progress being made and use old data to explore different interpretations.
- It helps the research community analyze and discuss experimental results.

ResearchAid uses the WWW to have students present, collect and edit information, through editable WWW pages and forms. Using the WWW for ResearchAid helps provide students with access to distant faculty and students for advise and feedback. The research laboratory that was the subject of the initial investigation had influential members of the research community located on different parts of the campus and the undergraduate students had little access to these people. To become a member of a community of researchers, a students needs to be able to meet with other students to work, discuss and create a shared understanding of their common needs and experiences (Selfe & Eilola, 1988). Because computer-mediated communication helps peripheral members of a community, such as undergraduate students in a university research laboratory, become more active in that community, it is hypothesized that these members will feel like a more important member of the organization and will be more committed to it (Eveland & Bikson, 1988; Sproull & Kiesler, 1990).

Future work on ResearchAid involves development of the final system (only a working prototype exists right now) and evaluation of how students actually use it in scientific research laboratories should also be conducted.

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Delivering Technology Education to Teachers via Web-Based Distance Learning

Wilhelmina C. Savenye, Ph.D.
Division of Psychology in Education, Arizona State University, USA
savenye@asu.edu

Introduction

Our university has offered distance learning courses for several decades. Like many universities, ours has in recent years encouraged faculty to explore uses of the internet for instruction. We currently have over sixty courses which use the internet in some way to deliver instructional materials, however most courses are web-supported, rather than fully web-based.

This paper provides a brief overview of the development, implementation, evaluation and implications of one of our university's first fully web-based courses, Teaching with Technology. This is a graduate course for teachers which includes both theory, design and considerable hands-on components. The presentation will describe in detail how the course was designed to prepare teachers to integrate many forms of technology, both computer and non-computer-based, into their teaching. Thorny development and implementation issues will be described.

We have been conducting ongoing developmental research while teaching the course. We conducted a case study evaluation of the course, and compared the results of the internet-only section with those of a campus-based section which utilized the same web materials. The course was offered again, in internet-only form, with refinements, during the spring semester of 1999, and we again collected qualitative and quantitative data to help us in evaluating and revising the course for delivery later in 1999.

The Teaching with Technology Course

Development of the course began in the spring of 1998. Although we have taught technology courses for teachers for many years, we began by analyzing the technology knowledge and skills teachers need currently to ensure that the course is up to date. We then determined the overall goals and objectives of the course.

The university's Distance Learning Division of the College of Extended Education was our partner in delivering the course. Distance Learning in 1998 used a "custom programming" approach to deliver internet instructional materials. The course instructor wrote the course materials and worked with the small Distance Learning programming staff to implement the web-based version of the course. The staff used web programming software and languages to build custom courseware wrapped around a commercial discussion software. This approach had its advantages, but also yielded several drawbacks which will be discussed in the presentation. For instance, we needed to develop a supplementary web site to support the course, and also used email communications considerably to ensure student learning and satisfaction. The course was next implemented, spring of 1999, using commercial web course development, with some custom elements.

The course is primarily designed for K-12 teachers and community college or university instructors. Some students enrolled in the course are typically also trainers from business and industry, therefore examples from both education and training are included.

This course provides students with an overview of the most effective ways to teach using various learning technologies. The course begins with a broad view of learning technologies and the research and theory related to using them. Students then learn how to apply instructional planning techniques to integrating technology into their instruction. We cover: advantages and disadvantages of various learning technologies, planning for technology, evaluation, and basic principles of educational technology development. The course consists of quizzes, short papers and projects, and a hands-on final project.

Course Components, Internet-Only Section:

The fully online course section initially included assigned readings in textbooks to provide the basic information, email communications software for instructors and students and a web site that is part of

Distance Learning's ASU ONLINE offering, which includes features such as "News" or announcements, an "Assignments" posting and submission area, "Test" features, a "Discussion" thread component for asynchonous postings, a "Chat Room" for synchronous discussions, and "Web Resources" and a course "Calendar" component.

During the initial course offering we revised components on an ongoing basis. One concern, for example, was that we did not truly know the needs of the students before they signed on for their first class, so we conducted a needs assessment with the students and revised the course topics somewhat to reflect their professional needs

Another particular concern was the need to have hands-on projects for teachers who have many different types of hardware and software, as well as resources and constraints, represented in their off-campus work settings. We have tackled this issue by allowing students a large degree of control in determining and completing projects, while providing them flexible guidelines and clear evaluation criteria.

We developed video clips included in a new "Media" component of the course. Clips show demonstrations of applications, technical processes and procedures, guest speakers and "virtual field trips."

We also developed a supplementary web site in response to the relatively long turn around time for custom programming. The site is used to provide information such as mini-lectures, extra text materials and handouts. It also serves as a substitute delivery medium for directions and assignments at times when the online course site components are not functioning as expected.

During the second semester of the course, spring 1999, we began to use CourseInfo 2.0 by Blackboard, Inc. This software provides us with easily updateable components and faculty can do these updates themselves. Another new feature is the provision of student home pages, allows students to easily present information about themselves and about projects they would like to work on collaboratively. The CourseInfo software will be described in more detail in the presentation.

Evaluation Methods

During the first pilot semester, Fall of 1998, we evaluated the effectiveness of web-based online delivery of this technology course for teachers using various methods.

We collected data on student learning by comparing overall student grades in the online and the campus section. We reviewed the quality of students' technology integration plans and final development projects. In addition, students' ratings of how much they perceived they learned were compared, along with their evaluation of the learning value of the course.

Student attitudes were measured using several means. Students in both sections completed a survey at the beginning of the semester in order to determine their needs and interests and incorporate these into the course. Students were asked at the mid-semester point to discuss aspects of the course and how the course could be improved for them. Finally, students in both sections completed a detailed course evaluation, focussed on determining the factors that helped them learn and what motivated them to learn.

Communication among students, the instructor and staff were analyzed. The discourse in the discussion threads was captured and these communications data were analyzed using qualitative methods, particularly content and pattern analysis. Also, patterns of communication and issues that arose in the email communications between the instructor and students and staff were analyzed.

The instructor and development team also kept ongoing logs of the issues and solutions that evolved during the course

Conclusion

Teacher educators are struggling with determining how best to deliver instruction to teachers on how they can integrate technology to help their students learn. In our presentation we discuss how this method is providing technology education to teachers who could not otherwise receive it. It is hoped that our discussion will provide other teacher educators with guidance for providing web-based technology instruction for teachers.

Network-based, High Bandwidth Multimedia in a 3rd Year Marine Botany Course Module

Jocelyn Collins & Derek Keats
Botany Department, University of the Western Cape, South Africa
e-mail: jcollins@uwc.ac.za & dkeats@uwc.ac.za

Introduction

In South Africa under Apartheid educational institutions were segregated according to pseudoracial categories. "White" institutions had the greatest advantage in terms of funding and long-term investment opportunities, while institutions categorised as "black," "Indian," or "coloured" were generally established much more recently and lacked the funding traditions and potential to develop their own investments. These institutions continue to draw their student population largely from a school system that was deliberately created under Apartheid to be inferior. This is particularly a problem in the sciences, an area that was previously denied access by the broader South African population.

We believe that the educational needs of students from disadvantaged backgrounds can be addressed by designing interactive, educational multimedia. This will allow students with different learning abilities to acquire a body of skills and knowledge at their own pace. In this context, we embarked on a programme of using computers and web-based technology within the context of mainstream teaching-and-learning.

The Educational Principles Followed

All course materials aim to promote meaningful learning (Ausubel et al. 1978), so that students come to exercise the higher intellectual processes of analysis, synthesis and evaluation. There is a tremendous inertia among students at UWC to focus on the process of memorisation (personal observation). Both multimedia and conventional resources for the course were designed in an effort to move students away from rote learning (Keats & Boughey 1993). The meaningful construction of learning is an active process, involving an interaction of students with a variety of learning resources (Jones et al. 1987, Moust et al. 1987). Knowledge construction can be improved through the use of preliminary organisers, such as statement of objectives and background knowledge required, as well as an overview of the material to be covered and the problems to be addressed (Melton 1984). Hence, web and multimedia resources are designed with clearly stated objectives as to what was expected of the learner.

The Technology and Development Methods

With a broadband network, the creation of deliverance of a full multimedia course becomes possible. A fairly static HTML webpage was created to allow basic concepts to be explored from workstations outside the ATM network. Multimedia is then used to add depth to the resources when they are accessed via workstations with higher speed connection to a network.

A small multimedia lab was established with all computers having a dedicated 10 Mb/s of Ethernet bandwidth linked to a 155 Mb/s ATM network. A multimedia web server is connected to the same Ethernet switch and the ATM network. In addition, a computer lab is available via the campus Ethernet backbone. For the first time this gives us the ability to provide students access to both web and multimedia facilities.

We have adopted an approach of developing teaching-and-learning resources that have the following goals:

1. At one level resources should be bandwidth-friendly. One of our goals in developing this course material is to have it available globally.

2. At another level resources should exploit the full potential of a high-speed network, and provide an exciting learning opportunity motivating students to break out of the bounds of conventional learning.
3. Resources should exploit the full potential of HTML and scripting to incorporate interactivity, thereby reducing dependence on additional software wherever possible.

On the surface, the first two goals seem to be mutually exclusive. How is it possible to minimise bandwidth use, while at the same time maximising the potential of a high bandwidth network? The answer that follows from these competing goals is a layered approach, whereby learning topics are covered using relatively static HTML, but in which users with high-speed access can go to another level with animation, sound, video and greater interactive control. This approach then provides the guidelines for a layered development of web-based learning resources.

The Research and Instruments

The work is being carried out under the framework of *Action Research* which is qualitative and cyclical, leading to ongoing improvements in action (Davidoff & Van den Berg 1991). Thus it is a suitable mode of research to inform on-going development, such as this project involves.

Two main research instruments are being used during this project: the interview and the questionnaire. In this project, a semi-structured interview is used as a means to gather information. Pre-formulated questions will guide the interview, but they will be open-ended ones which Cohen & Manion (1980) defined as "those that supply a frame of reference for respondent answers, but put a minimum of restraint on the answers and their expression". Interview results are used to inform the Action Research in that the data and recommendations will be subjected to evaluation and the actions within the project (multimedia content and activities) subjected to revision accordingly. The lecturer will be interviewed to determine content that is most appropriate to be enhanced using multimedia activities, and the students to determine their area of greatest difficulty that can be addressed by incorporating more interactivity. Once the students are using the facilities, they will be given structured questionnaires, and will be observed and interviewed as they use the multimedia lab.

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Effective Distance Education Via Interactive Video

Kara L. Nance and Mahla Strohmaier
University of Alaska Fairbanks, U.S.A.
ffkln@uaf.edu ffms@uaf.edu

Introduction

Educational opportunities are reaching populations heretofore left out of the equation thanks to distance education technologies and institutional desire to expand the student base. Once a component of only the richest universities, distance education technologies are becoming more affordable, enabling incorporation by a significant proportion of the university community. One of the most popular technologies, and the one compared most directly to face-to-face interaction, is interactive video. This relatively new technology has provided instructors with the ability to reach new student populations as well as expose traditional students to new peer groups. Although many institutions have interactive video equipment and are using it, the focus in training remains on the course content. The interactive dimensions are rarely touched upon during faculty training for those using interactive video to conduct courses. As with other forms of distance education, the acquiring of delivery skills associated with interactive video teaching is generally through practice, or trial and error might be more descriptive. In essence, the classroom becomes the testing laboratory, influencing the learning process during that preliminary stage. To facilitate effective learning for the students, and to alleviate unnecessary aspects of teaching and credibility problems for the instructor, faculty training must be targeted directly and appropriately at the technological and social dimensions involved in interactive video instruction.

Course Integration

When using interactive video in teaching, the interactive video is so much a part of the course that it influences the course content and structure directly. In order to construct an effective syllabus, the instructor must have a working knowledge of all the dimensions of the influence the interactive video format will have. Interactive video, as a mode of communication, can be very effective if it is a tool that has been mastered. An instructor who does not have an understanding of the technology involved will find it a hindrance that can actually block the educational process.

When selecting a person to teach a course, there is no doubt that the credentials of that person will be thoroughly examined. That person will be expected to have college degrees, generally in a field containing or directly related to the course being taught. Previous experience in the classroom is examined, including sample student and peer evaluations, as to the goodness of fit for the applicant and the institution and class. However, when selecting the person to teach via interactive video, where did the inquisitiveness go? Generally the person assigned to the interactive video course is the person who happens to already be teaching the course that is desired, the person who has the desired time-slot available, or the person who seems to mind the imposition the least. Once that person begins to teach, it is still unclear where they can go for help—with the possible exception of technological problems that can be asked of attendants on duty during the class. Thus, the students see the instructor less than prepared, asking questions, and showing inadequacies. This appearance will then lower the perceived credibility of the instructor, even though it is based on non-content issues.

Student Dynamics

The classroom interaction dynamics are greatly effected in a class delivered via interactive video. Although the individual compositions may vary, the "group" of students is generally at least two separate groups, sometimes three or four, attempting to merge into one class group. "The primary group is that which is physically with the instructor. The secondary group is that which perceptually resides in the television" (Nance & Strohmaier, 1998). For effective interaction in the classroom, the students must perceive the physically separate groups as one class group. Accomplishing this goal can be difficult for an instructor, especially if he or she is unaware of this potentially disastrous dynamic issue. Faculty development could address this issue.

Another major area of impact lies in the visual perception engendered in interactive video. As a member of the primary group, the instructor sees fluid movement in the physically present group, and visual compression with the secondary group images. As the students are listening, this visual compression does not appear to have a significant impact. If the instructor was to trade places with a student in a secondary group, he or she would see the magnitude of the impact of visual compression. The visual cues of the instructor are not fluid, thus dividing the focus of those students. Other interaction components are also effected by this lack of visual flow, such as with turn-taking behaviors. "The way an individual knows that it is his or her turn to speak in a conversation is through pause time, eye contact changes, altering the tonal pattern of the voice, and posture adjustment. Although the students can note the pause time and tonal differences in an interactive video setting, the eye contact and posture adjustment are not easily read" (Nance and Strohmaier, 1998). The vocal aspects of the interaction are however generally in real time, which can compensate for some of the interaction cues that are taken away in the visual mode.

Just as the dynamic effects of the interactive video mode have far-reaching consequences, the potential confusion regarding turn-taking behavior has several ramifications. When faced with a long pause time people feel uncomfortable and begin to get restless. To alleviate the situation, someone will end the pause through verbal interaction. In an interactive class, the primary group will be privy to all of the pertinent interaction cues as to turn-taking behavior. They will have the insider information as to when the instructor is actually looking for an answer, versus stating a hypothetical question. The students in the secondary groups will not be sure which is the case, and will therefore choose the polite path and wait longer before answering. In this situation, then, the students in the primary group will generally always be the ones to break the pause-time. The routine will become standard, and the secondary groups will be both perceptually and actively removed from the discussion core. To avoid this scenario, the instructor must overtly draw in the members of the secondary group through directed discussion. Again, faculty development should address these issues to ensure that the faculty member is adequately prepared to handle these situations and facilitate meaningful interaction between groups.

Conclusion

Distance education is a timely concept. Although in existence for decades, technological developments have created many new dimensions and possibilities for distance education. Much research is being done on the potential and use of distance education, with a focus improving the technologies. Research must branch out and enhancing the capabilities of the instructors through formalized faculty development programs as well. Rather than instructing faculty based on crises that arise during interactive video classes, faculty development should be approached in a proactive manner to avoid the crises before they occur. In this age of serious budget considerations, the institution would benefit financially with this approach as well.

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Haptic Virtual Reality for Training Veterinary Students

Stephen Brewster, Michelle Montgomery Masters, Aidan Glendye
Glasgow Interactive Systems Group, Department of Computing Science, University of Glasgow, email : **stephen@dcs.gla.ac.uk**, **michelle@dcs.gla.ac.uk**

Stuart Reid
Veterinary Informatics and Epidemiology, Universities of Glasgow and Strathclyde

Nik Kriz
Weipers Centre for Equine Welfare, University of Glasgow

Section 1: Introduction

This paper reports on an initial and on-going study into the use of haptic (Schiff & Foulke, 1982) technology in veterinary education. The University of Glasgow has a commitment to the implementation of non-invasive procedures for diagnostic and education purposes in Veterinary Medicine, wherever possible. As part of the continued development in the use of technology in veterinary education, Virtual Reality is now being explored as a possible aid to teaching and in particular to replace invasive examination procedures.

Section 1.1: The problems

One major problem in the education of veterinary students is the danger faced by animals when being examined by inexperienced students. The students need to gain experience in internal examinations (a key method for diagnosing problems and diseases) but it can be dangerous. The animals may become stressed, be injured or may even die because of unskilled internal examinations. Large classes of students mean that each person may only get a very limited amount to time learn the practical examination skills required. Another problem is that the students must learn about a whole range of diseases and problems as part of their education. At the time during their training when they are learning about a particular disease there may be no animal available with the particular disease in question. This means that students may not be able to consolidate their learning with practical experience.

Section 1.2: The solutions

We are investigating ways to solve these problems by using haptic devices that allow users to feel virtual objects. There are three main benefits from our solution:

Safety: The use of haptic models to simulate problems allows the students to learn in a safe environment. They can learn on the models without endangering any animals. Once they have gained sufficient skills on the models they can then move on to the live animals with much less chance of doing harm.

Cost: The cost of education is also reduced. A large number of students can interact with the haptic models very quickly and cheaply. They can also do this much more frequently than would be possible with live animals.

Flexibility: The flexibility of the models is great. It is possible to simulate a range of diseases that the students would not normally experience. Different stages in the progress of a disease or condition can also be simulated. This can be done at the time the students are learning, allowing them to try out their theoretical knowledge immediately in a practical setting.

Section 2: The technology

The technology to feel virtual objects is just now becoming available (Massie & Salisbury, 1994, Bryson, 1995).

It was first developed so that users could feel objects in virtual environments. Minsky (in Blattner & Dannenberg, 1992) describes the technology thus: "Force display technology works by using mechanical actuators to apply forces to the user. By simulating the physics of the user's virtual world, we can compute these forces in real-time, and then send them to the actuators so that the user feels them". The device used for the work described is a PHANToM. This is a very high resolution, six degrees-of-freedom device in which the user puts his/her finger in a thimble or holds a pen at the end of a motor-controlled, jointed arm. It provides a programmable sense of touch that allows users to feel textures and shapes of virtual objects, modulate and deform objects.

Section 3: The haptic models

As mentioned, we are developing haptic software models that will simulate the feel of parts of a horse under examination. This shows two horse ovaries. The ovaries feel correct and they move in appropriate ways (if pressure is applied they can be moved in three dimensions in a realistic way). Both ovaries have very smooth, taut surfaces. The left ovary is softer and slightly smaller than the right one. A follicle can be seen on the left ovary (indicating ovulation is about to take place). This sticks out from and is much softer than the rest of the surface. The visual representation of the ovaries is built in OpenGL. The haptic representation is built using the GHoST software toolkit from SensAble. When vets are doing internal examinations they cannot see the ovaries, so the visual images are mainly for illustrative purposes. However, a visual representation is beneficial when learning to use the system. Our software allows the visual representation to be removed as required. The PHANToM device only allows the user to feel with one finger, not the whole hand. This, however, is not a limitation as vets will only use their thumb when feeling the ovary in a real examination.

Section 4: Evaluation

The development of the models has been performed using an iterative, participatory approach. Computing scientists have been working closely with vets to ensure that the models are correct. This has involved the building of initial prototype models and their continual refinement via expert user evaluation. The next stage in our work is to carry out evaluations with vet students. We will discover if the models are usable: can the vet students interact with them, use the device, etc. We will also be able to find out how effective they are: can students correctly identify the particular diseases and conditions we have simulated in our models.

Section 5: Conclusions

One problem in veterinary education is that students must learn how to do internal examinations of animals but in doing so can be dangerous for the animals. Another difficulty is that there may not be an animal available with a particular disease when the students are studying it. The availability of haptic devices means that these problems can now be overcome. We have developed a set of haptic models of horse ovaries that will allow students to learn in a safe, cheap and flexible environment. Once they have learned the necessary skills they can move to working with live animals with much less risk of danger.

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A System of Designing User Interface to Promote Collaborative Learning in Cyberspace

Kaname Takamori
Graduate School of Media & Governance, Keio University,
Japan
kaname@sfc.keio.ac.jp

Introduction

With the spread of Internet, the source of information surrounding us diversifies. As a result the burden for gathering and sharing information for analyzing problems suddenly increases in a real business. Such a change gives a big influence to learning environment for both an individual and a business organization. For one of representative cases we can point out the trend that "Knowledge Management" attracts many people in the field of business. In other words, they need a continuous collaborative learning that is attached great importance to experience in a real business in order to cope with such a difficult situation. Teams are organized according to interest domains, and we expect that participants in teams search information from their various points of view. By exchanging many opinions with members, they will share a hypothesis and information furthermore, and through collaborative activities they will share a lot of experience and learn how to make a new concept. Such a learning method is called "Collaborative Learning" or "Action Learning", and many people trend t think that this is a kind of team learning (or team teaching), that attached great importance to such a process. The purpose of this paper is to show the usefulness for the system of designing user interface to promote and support a practice of them.

Problems of "Collaborative Learning" or "Action Learning"

Judging from examples of education in a corporation as before, the biggest problem is that "long time is necessary in order to get effect" when we practice "Collaborative Learning" or "Action Learning".

The result of our experiment clearly shows that an equal characteristic was found in apportioning time according to an activity process in inspection experiment of two sets. The graph in Figure 1 shows that in both sets the ratio of a process of gathering information (including Experiencing and Publishing) is very high, and a ratio of a process of opinion exchange and the logic construction (including Processing and Generalizing) is lower. As this reason, when learning persons accessed the various source of information that they hadn't used, they tended to have a long time to gather information (including grasp of characteristic information and the way to access to every the source of information). We used the analysis of the log of experiments and questionnaire investigation to learning persons in order to report this result.

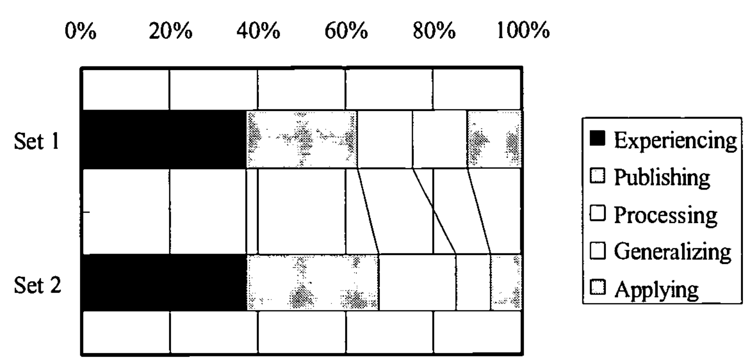

Figure 1: The ratio of apportioning time

Schemes and Effects of the system

In this study, we establish the following point of view of solving problems of these learning methods.

- By filtering necessary information from the various source of information, several learning persons and teacher (facilitator) build the structure that gathering and sharing information become possible effectively.
- By re-organizing much information collected by all the participants, we build database environment to structuralize the information flexibly according to a purpose.

According to basic concept of a system, we build a system with C/S application of Web base shown by Figure 2. The system has the following characteristic.

This system collects interest of learning persons with questionnaire system beforehand. Based on these interest profile databases, this system can automatically form interface for every learning person and a team. In next, by the key word they prepare, they can search several database and WWW simultaneously and output search results. And, on the basis of interest profile and their rating, this system has a function to recommend information that other learning person collected (utilized by push technology and collaborative filtering technology). Facilitators can manage monitoring of access situation. Finally this system has a database including input interface of outline processor type. This database can organize it accounting to own participant's logic for all the information that they collected again.

In the whole activity, about around 5 % ratios of gathering information did decrease as a result of having introduced this system in practice process of Action Learning. By sharing gathering information process with other participants, reduction of about around 10 % gathering information costs was more effective than experiments before introducing system.

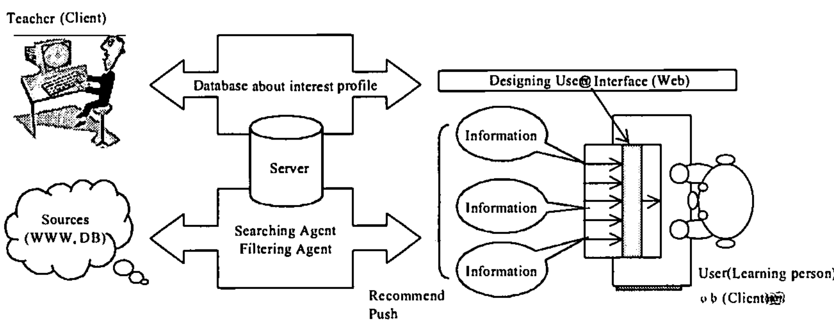

Figure 2: Characteristic of the system

Conclusion

So far we have outlined the concept and design of system. In concluding, we should note that this system principally effective for shortening an apportionment of gathering information process when practicing these methods. The Future direction of this study will be to extend this system examine structure clearing and managing a copyright of digital content.

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MULTIMEDIA SYSTEMS: A NEW TECHNOLOGY IN THE HEALTH EDUCATIONAL CONTEXT

Elomar Christina Vieira Castilho Barilli
Oswaldo Cruz Fundation –Public Health School – Secretary of Educational Technology Coordinator R. Leopoldo Bulhões –térreo –CEP. 21045-900 –Rio de Janeiro –Brazil. barilli@ensp.fiocruz.br

1. Introduction

In thc sphere of health, the introduction of new technologies in the educational context is taking place in an international scale, with the development and adequation of computer systems that deal with informations in an optimized way, as relates to the efficiency of access, recovery, presentation and dissemination, at the same time that they treat in an adequate way the psychopedagogical issues involved in the learning process. This is certainly not only due to the complex and diversified nature of the information that is always in expansion in the field of health, but also to the very quantity of information that needs to be dealt with in this field, allied with the advancements in computer sciences and telecommunications. All these facts result in the need of development of products related specifically to the health field, carried out by professionals that should not only dominate the theoretical and practical knowledge of the relevant aspects, but should also be in close contact with the main advances in this field. The Oswaldo Cruz Fundation - FIOCRUZ, well known for its experience in teaching and research, with highly qualified professionals, turns its interests towards the education and training in the field of the health sciences, developing, distributing and evaluating educational products based on multimidia technology (hipertexts), focussing on the theoretical- practical knowledge of the targets that are most in demand from the scientific community, including graduate and undergraduate students from the Brazilian institutions of teaching and research.
The spheres of development of these systems are necessarily multidisciplinary, demanding an interdependence of knowledge. That is why, besides the team that is considered the *basis* (biologists, system engineer, visual programmers) other teams composed of pedagogues, psychologists, computer science professionals and fotographers will be formed in accordance with the subject to be dealt with. The encounter of the teams is taking place in the National Public Health Scholl -Secretary of Educational Development (SDE/ENSP), a point of intra and interinstitutional integration, where efforts are joined in order to promote a qualitative leap in the educational products issued by the society.

2.Projects in Course

A. HIPERGIS: a hypermedia system on techniques of spatial mapping and systems of geographical informations for the health field. CASTILHO-BARILLI ECV[1]; NOBRE FF[2]; CARVALHO MS[3] / [1]Nacional Publuc Health School /FIOCRUZ; [2] Biomedical Engineering Program COPPE/UFRJ;[3]Nacional Publuc Health School
The main objective of this work is to favour the routine employment of spatial analysis in managing processes of public health with the usage of techniques of spatial mapping through computerized Geographical Information Systems, as it is believed that this type of analysis facilitates its steps in relation to time spent, costs involved and also in what concerns the broadcasting of its results. The HIPERGIS is a hipermedia system, whose aim is to aid in the acquisition of knowledge about the techniques of spatial representation of data, as well as in the employment of computerized geographical information systems, through the training and/or improvement of the professionals who work in the health field and undergraduate and graduate students, therefore mending a gap in the knowledge of these people who, in general, do not have access to these subjects in their graduation studies. The data basis of the hipermedia is composed by specialized mainly derived from textbooks on cartography and scientific articles. The so-called "authorship tool" used for implementing the basis of knowledge of the HIPERGIS was the Multimedia software Toolbool 4.0, since it was easily handled and it presented a good cost-benefit relationship. HIPERGIS is divided in 4 main modules: 1) *Help*- subdivided in: a) descriptions on its navigation and b) Hipertexts: historical, definitions and applications; 2) *Basic Concepts* - topics on cartography; 3) *Spatial Representation* - descriptions of the spatial mapping techniques with graphic examples (maps) and 4) *Systems of Spatial Informations*- in this topic one includes the GIS. The buttons constitute the main means of navigation of the system. They are disposed, in a pattern, at the inferior left corner of each screen, being divided in: *Fluxogram* - presents the topics and subtopics, *navegate??* - summary-screen that explains the function of each botton, *return to the beginning button*- sends the user to the page or the introduction screen of each topic or chapter; *Main Menu*- presents the main modules; send *page forwards and backwards* and *exit button*- ends the system. The system still offers a screen or page of glossary, with a list of words in alphabetical order. The minimal technical requirements for the HIPERGIS use with a good

performance are: a microcomputer PC-486, with 16 Megabytes of memory, 12 Megabytes of free space in hard disk, SVGA monitor with a 1 Megabyte plaque configured for 256 colours, as well as an MS-Windows 3.1 File Manager (which fits perfectly well the more modern versions, like Windows 95).

B. *Development, Application and Evaluation of Multimedia Systems on the Main Human Parasitic Disseases for Health Education* . [1]ELOMAR CHRISTINA VIEIRA CASTILHO BARILLI; [2]LUIS REY; [3] ANTÔNIO J S DE PAIVA; [4]LUCIANO DE PAULA /[1]ENSP -Oswaldo Cruz Fundation; [2]Tropical Medicine Department - IOC/FIOCRUZ; [3,4]SDE/ENSP The main HUMAN PARASITIC DISEASES constitute the central target of this work, which is meant for graduate and undergraduate students of the national institutions dedicated to teaching and research. The first theme to be dealt with is Human Malaria, its meaning, characteristics, ways of treatment and control of the disease. The level of information to bc followed is the basic one, and, as information source, the texts of the following books are being employed: Parasitologia, Bases da Parasitologia Médica and Dicionário de Termos Técnicos de Medicina e Saúde, all being written by Dr. Luís Rey. The multimedia is divided into five main modules: *Introduction*-made up of a video; *historical*- with a slide show linking an audio file with historical photos that are presented on the screen; *the parasite*- morphology, evolutive cycle and physiology; *the mosquitos*- morphology, biology, collecting and control and *the disease*- pathology, diagnostics and therapeutics, epidemiology and control. The system contains, besides the strong textual content, schemes, videos, photos, and, animations. The basic programme used for the implementation of hte system is the AuthorWare 4.0. It will be applied in samples students from the graduate courses of FIOCRUZ, undergraduate Medicine students from Rio de Janeiro Federal University, as well as in opinion and suggestion surveys with teachers and researchers linked to the teaching of the health sciences. This work will bring, as final result, a product of multimedia software, available, initially, under the form of CD-ROM and, after the revision step, at the Internet. This work is being developed with the purpose of offering a facilitating means of cognition that could be applied as an optimizing factor in the acquisition of specialized knowledge in an individual and pleasant mode, thus favouring the introduction of new environments of teaching/ learning and recycling in Parasitology.

C. *WARNING SIGNAL: an integrating signal between environment and health.* DANIELLI GRYNSZPAN; ELOMAR CHRISTINA VIEIRA CASTILHO BARILLI/ Oswaldo Cruz Fundation

This work seeks to present a dynamic and interactive pedagogical product, which might contribute to the raising of the consciousness of the intrinsic relationship between ecology and health. Through education and reflection on the triad : human being, health and environment. WARNING SIGNAL will be put at the general disposal in The Biodiscovery Space, that belongs to the Science and Technology Museum, *The Museum of Life*, that is being implanted at the *campus* of FIOCRUZ. This work presents an effort made towards offering teachers, pupils and other citizens, that should come to the Museum, a starting point for the exploration of themes linked to health and environment that would lead to a basic principle, linked to both, that is the constant fight for improvement in the quality of life. This work still intends to develop in the user a critical posture in relation to his rights and duties as an individual, of fighting for good life conditions, for himself and the community. Summing up, one intends the Warning Signal to develop in the visitor of the Biodiscovery Space of the Museum of Life/FIOCRUZ a holistic perception of the touchstones of education in health and ecology

3. General Conclusion and Perspectives

The multimedia technology was selected as the adequated environment to implement the systems because permit its utilization for people without previous experience in the use of computers and its efficient manipulation of large volumes of text and images. At the present stage the system has been implemented only in Portuguese. These products, at first, will be implemented in CD-ROM, and, later (after the evaluation methodology), made available through Internet. The methodology evaluation will be carried out with professionals whose specialities are linked to the theme dealt with by the system in relation to the technology employed, as well as the target public of the system, according to these steps: *preliminary questionnaire* (that seeks to collect information on the user experience within the theme to be presented, computational experience etc), " and *evaluation questionnaire* (collecting of opinions, observations and criticism). The intention of the professionals from SDE/ENSP is that it should not only be a place that would produce tools to sustain and amplify cognition, but also contribute for research on the efficacy of its very function: that of the knowledge communication and integration of FIOCRUZ researchers with professionals from other institutions. Our hope, in fact, is that it may contribute both for technical - scientific development and for the educational development in the field of health.

SCALING INFORMATION LITERACY AT THE UNIVERSITY OF IOWA: WEB-BASED APPROACHES

Barbara I. Dewey, University of Iowa Libraries, University of Iowa, U.S.A., barbara-dewey@uiowa.edu

This short paper discusses issues and strategies related to scaling information literary programs in the large university setting. The University of Iowa Libraries' multi-format approach in attempting to reach more of its 28,000 students will be described with a focus on web-based delivery systems developed in partnership with Colleges and academic programs.

THE NEED:

- The information environment is too complex and changing too rapidly to expect students to acquire information literacy without a planned, systematic, cumulative instructional program.
- Students must learn critical thinking and research skills as preparation for a lifetime of changing information needs.
- Effective learning about information retrieval, use, and analysis is tied to a particular information need, often discipline-specific.
- Students have different learning styles and acquire information in different ways. Any information literacy program must accommodate these differences by using a variety of approaches that provide practice in these skills.
- The most effective way to reach students is through collaboration between the Libraries and academic departments and faculty in integrating information skills into the curriculum and evaluating outcomes through a variety of means.

INFORMATION LITERACY LEARNING OBJECTIVES:

- Identify and articulate needs that require information solutions;
- Identify appropriate information sources and execute search strategies appropriate for each resource;
- Interpret and analyze search results;
- Critically evaluate the information retrieved;
- Organize, synthesize, and apply the information;
- Understand the structure of the information environment and the process by which both scholarly and popular information is produced and disseminated; and
- Understand the ethical issues related to access and use of information.

TIER ONE: A tiered approach that builds on knowledge acquired throughout the students' career has been developed including strengthening the current introductory research and information seeking components in two products:

- *Online Iowa* – updating/enhancing library section of a general university CD-ROM orientation program that provides a basic understanding of Main Library service points and examples of where to search for information resources (http://www.uiowa.edu~online/).

- *Library Explorer* – strengthening the existing partnership where library staff provide instruction on how to integrate the use of Library Explorer, a computer-based library instruction program with automated "quick tests of knowledge", other information sources, search strategies, and development of effective research-related assignments for teaching assistants within their training program. Librarians are subsequently paired one-on-one with Teaching Assistants to provide customized support. Extensions underway for Library Explorer include subject-specific "chapters" for different disciplines and special CD-ROM "cuts" from Library Explorer to use with distance education students who do not have access to the Internet (http://www.lib.uiowa.edu/libexp/).

TIER TWO – UTRIPLE I: Librarians work with faculty to determine a desirable combination of instructional formats, assignments, and outcome evaluation methods building on experience derived from current and past partnerships with GER and upper division course instruction for tier two components in an initiative called UTripleI (University of Iowa Information Literacy Initiative) for:

- *General Education Requirement Courses* -- introductory subject-based information literacy component developed with faculty and built into selected GER courses selected from the Departments of English, Geography, History, Political Science, and Psychology including query formulation, information seeking strategies, basic evaluation of information sources, and a basic understanding of copyright and intellectual freedom issues.

- *Science Information Literacy Initiative Project* – development of specific information literacy components related to the special needs of science disciplines and their courses.

- *Undergraduate "Majors" Component* -- advanced and more complex subject-based information seeking, retrieval, and analysis components built into selected courses for undergraduate majors.

TIER THREE – FACULTY TRAINING AND SUPPPORT: Efforts to scale information literacy efforts through faculty training include programs for on the application of learning technologies in their courses:

- *nTITLE* (New Technologies in the Teaching and Learning Environment – website noted below) is a summer faculty training program taught largely by librarians. The Center also provides input into the University Libraries' TWIST (Teaching with Innovative Style and Technology) project (http://www.uiowa.edu/~ntitle).

- *TWIST (Teaching with Style and Innovative Technology)* is a three year grant funded program whose major goal is to create a model program for training faculty to integrate networked information into teaching as well as information literacy components. TWIST project staff are sponsoring a series of late summer workshops for faculty and staff to explore ways of fully using information technology in instructional settings. The sessions focus on building learning environments for students - how to help students learn to use electronic resources via OASIS (the University Libraries' online catalog), the Web or CD -ROM; how to build instructional Web sites to guide students as they learn critical thinking skills. One "scaling" factor in this program is the development of web-based tutorials for faculty to use at anytime. Another scaling factor is the development of a TWIST "template" for faculty to develop course web pages with an emphasis on linkages to resources and information literacy-based lessons (http://twist.lib.uiowa.edu).

SUMMARY

Issues and challenges to scaling efforts with be reviewed including the need to "mine" partnerships with faculty and technologists, the need for improved marketing of the inherent benefits of integrating an information literacy component into one's course, the difficulty of measuring and evaluating the success of a "scaled" information literacy program, and the challenge of putting together a coherent program or curriculum in an easily translatable modular form.

Multimedia Communication - A National Program for High Schools to Develop Professional Multimedia Skills

Ricardo Dal Farra
Multimedia Communication
National Institute of Technology Education (INET)
National Ministry of Culture and Education - Argentina
dalfarra@clacso.edu.ar and dalfarra@inet.edu.ar
http://music.dartmouth.edu/~ricardo/index.html

The New Educational System of Argentina

In Argentina we are living an advanced stage of what we call "educative transformation". This embraces from student's early years, when them goes to the General Basic Education (GBE) right after the kindergarten, and includes also the high school level, both technical and non-technical.

Our new system introduce 9 years of general education organized in 3 stages of 3 years each (GBE I, GBE II and GBE III), while the previous one had only 7 years. After this, the project includes Polimodal Education (PE), another 3 years where students receives more advanced general education while at the same time follows one of five basic orientations we call "modalities", that can be chosen between: Communications and Art, Management and Economy, Natural Sciences, Production, Humanities and Social Sciences.

To receive a technical diploma is possible to take (parallel to the "Polimodal Education") one of a series of "Technical-Vocational Pathways" (TVP) pointing directly to develop professional skills around different professional areas of the work world of today.

Technical-Vocational Pathways

The education by competences is on the basis of all the "Technical-Vocational Pathways" developed. These programs were created considering the present situation of the educational system in our country and the neccesities for the future. We worked consulting permanently both to the different levels of the educational system as well as the productive world.

Each "Technical-Vocational Pathways" (TVP) focuses on a work area of the real world and the professional skills needed there. Among the **TVPs** developed are: Informatics, Agriculture, Industrial Process, Organizations' Management, Electronics, Health and Environment, and Multimedia Communication.

Each **TVP** proposes a modular organization where each module focuses on certain competences related to the field of work involved, developing a coherent body of competences to receive the diploma on the specific technical area of interest.

TVPs are between 1200 and 1800 hours long, and the modules of their structure can be organized in three years, following steps of progressive complexity.

A partial option to the technical diploma are the "Itineraries", when students takes only certain modules limiting the general field of study to develop only a group of competences coherent with an specific trimming of the field focused by the **TVP**.

Multimedia Communication

The "Technical-Vocational Pathway on Multimedia Communication" have been developed by a small group of multimedia producers, artists and pedagogues working since 1996 on the program.

A national program on multimedia communication for high schools in our country needs to solve several problems to start, being faculty training on new areas of knowledge and work, and the equipments required just some of them. Also must be considered the social situation of a very large country where almost half of the population is concentrated on the capital city (Buenos Aires), thinking that while there are small to big companies based there around the wide multimedia market, mainly small groups are working on this field on the rest of the geography. So related areas to multimedia should be considered into the project's structure considering the employment opportunities in small cities while the specific multimedia field grows there.

The modular structure is built with 16 modules of 96 hours each, plus one of 144 hours (total = 1584 hours). These modules are organized in 6 modular areas: Script, Images, Sound and Music, Multimedia, Management and Technologies that groups them.

While the other "Technical-Vocational Pathways" are only technically oriented, this program joins art and sciences concepts with direct experiences on new technologies. Not all modules on Multimedia Communication looks for specific competences, some of them on the first level of complexity (= first year) serve as an analytical introduction with artistic elements to the visual and the sound/music world (Visual Morphology, Sound Morphology), while others (Science and Technology Elements) put the basis to understand many processes involved on modules of the second and third level. Modules like Script, Desktop Publishing, Image Synthesis and Animation, AudioVisual Realization, Sound Technology, Production, Multimedia Introduction, Closed Multimedia Systems, Open Multimedia Systems, Management and Marketing of Micro-Enterprises and Equipments Maintenance focuses on specific competences of the field. On the last step of complexity, Integration Project and Training on Work Centers modules looks both for coordination and integration of efforts as well as for complex experiencies useful on the real world.

About the modules, there are no breaks between theory and practice on them; learning is taken as a process where different aspects are necessary to reach the knowledege and skills to work on the multimedia field. Basic science concepts are important, as well as practice with suitable technologies to solve real world problems using a creative approach. About each module itself: on the **first** level of complexity, Script starts with traditional, linear scripting for different medias, goes through parallel and multiple stories, ending on hypermedia scripting; Visual Morphology takes both, fixed images and moving images, approaching also the relationships between images and sound; Sound Morphology focuses on sound and music perception, analysis and creation; Multimedia Introduction goes from the perceptual, aesthetical and technical analysis of multimedia projects to the production of basic hypermedia works; Science and Technology Elements works over the basis of light, sound, electricity and electronics to understand processes learned and technologies used through the TVP; on the **second** level of complexity, Desktop Publishing is focused on the visual articulation between text and fixed images; Image Synthesis and Animation takes both, the 2 and 3D worlds; AudioVisual Realization works over the full process of capturing and editing real moving images and their integration with the sound world; Sound Technology is focused on synthesis, recording, processing and mixing of sounds and music; Closed Multimedia Systems points to multimedia/hypermedia products where information flows mainly inside closed environments of use (as in most CD-ROMs products); Production is focused on the management of each project step; and on the **third** level of complexity, Open Multimedia Systems points to multimedia/hypermedia products where information flows on open, distributed environments of use (WWW); Management and Marketing of Micro-Enterprises points specifically to those wishing to start their own business; Equipments Maintenance is planned to help to identify and solve simple computer and AV fails; Integration Project is where the more complex and interdisciplinary projects happens; and Training on Work Centers put students on the real world of work so they can make their own experiences, using this to analyze techniques, processes, products and situations to help them to progress from there and complete this stage of learning.

Together with the 16 modules, students needs to take some subjects from the "Polimodal Education" too: Communication, and English I-II-III. It must be considered here that in spite is mandatory to receive a "Technical-Vocational Pathways" diploma to complete also the "Polimodal Education", there are some electives subjects on this system, making neccesary to remark those two areas (Communication and English) as essentials to fufil the goals. While in Argentina the official language is Spanish, students could study French, Portuguese, English, German or Italian as foreign language on the high school, thus making necessary for us to take a decission regarding which is the language needed at present for those starting on the multimedia field: (at least, three levels of) English. About the high significance of Communication for this TVP, it must be remarked that settle fundamental (communication) concepts needed for most of the modules of the second and third level of complexity.

As a shorter option to the technical diploma on Multimedia Communication, students can receive a certificate on Desktop Publishing, Image Synthesis and Animation, Audiovisual Realization or Sound Recording and Processing approving only certain modules to develop a group of competences coherent with the named specific fields ("Itineraries"). As an example, to receive a basic certification on Image Synthesis and Animation (an "Itinerary" with a total of 576 hours) students must to approve the following modules: Script, Visual Morphology, Image Synthesis and Animation, Multimedia Introduction, Science and Technology Elements and Equipment Maintenance; in addition, is highly recommended (not mandatory as for the full technical diploma) to take the Communication, and English I-II-III courses.

This program starts in public schools of Argentina in March 1999.

A large scale Internet based course for computer beginners

Dr. M. J. Weller
Faculty of Technology
The Open University
Milton Keynes
MK7 6AA
United Kingdom
e-mail: m.j.weller@open.ac.uk

Introduction

T171 *You, your computer and the Net,* is a distance education course presented at the Open University in the UK. The course was piloted in 1999 with 900 students. It is a foundation course, which provides a grounding in computer skills and knowledge of the personal computer and the Internet. It is a broad appeal course aimed not just at Technology students, but students of all Faculties, as well as a general audience who may only take this one course. The course is presented entirely over the Internet, with most of the material being web based, and extensive use is made of computer conferencing.

The course was developed to reflect a Kolbian iterative learning model [1], which had been used successfully in other OU courses [2]. The model has the following three main phases:

- Conceptualisation - the learner receives information about other people's concepts;
- Construction - the learner uses such concepts to perform meaningful tasks;
- Dialogue - the learner tests existing concepts and creates new ones through dialogue with other learners.

With this model as a basis, and the following aims, the course structure could be developed. The initial aims of the course team were as follows:

1. To produce a large scale, broad appeal ICT course
2. To make the Internet the central delivery mechanism
3. To produce a course in a relatively short time scale
4. To make students feel comfortable in the 'wired world'
5. To bring the OU's traditional standards of production to the Internet.

There is an initial face to face session, which operates as an introduction to the University as a whole, and to distance learning. This is not course specific, and the emphasis on face to face was kept to a minimum in order to utilise the advantages of computer mediated communication (CMC) tuition for distance learners with diverse lifestyles.

Course structure

T171 is based around three modules, two of which have a set book. The web site is then used to add academic material exploring issues raised in a chapter of the book. Students also have access to a number of conferences. The modules are outlined below:

Module 1 You: Computing with confidence

This starts from the beginning and assumes that at least some students are completely new to computing. It covers general computer skills such as: the basic operating principles of a PC; the *Windows* interface; an introduction to standard office-type programs for word-processing, database operations, spreadsheet calculations and simple charts and graphs; the use of modems, electronic mail and conferencing; connecting to the Internet; using a Web browser; searching the World Wide Web on specific topics; planning, designing and authoring Web pages; Netiquette and principles of online behaviour.

Module 2 Your Computer: The story of the PC

This module is based around the story of how the personal computer came to be one the dominant technologies of our age. It starts with the invention of the microprocessor and leads up to the present dominance of Microsoft. It is based around an accessible set book [3] and a web site containing a large amount of additional material, study guides, links, resources and assessment material.

The module looks at the key technologies involved with the PC such as the microprocessor and the operating system and explains their importance and how they work. It also looks at the social implications of the IT revolution, the nature of the computer industry and the reasons behind the success and failure of computer products.

Module 3 The Net: Where it came from, what it is

This covers the evolution of the Internet from its origins in the inter-war years through to the explosive growth of the World Wide Web in the 1990s. It is again based around a set book [4] and a web site.
The Module covers the history of the Net in four stages:

- Prehistory: the evolution of ideas about computing and communications from the 1930s to the 1960s
- The ARPANET: the creation of the first packet-switched wide area network
- From ARPANET to Internet: the metamorphosis of the original ARPANET concept into the 'global network of networks' which constitutes today's Internet
- The World Wide Web: the evolution of the Web from its invention in 1989 to its current form.

Module 1 is largely activity based, and thus incorporates both the conceptualisation and construction phases of the learning model within the material. Modules 2 and 3 are more content based. In this respect, the web based material represents the conceptualisation phase. In order to make it active for the student it is necessary for them to engage with the material in a manner which personalises it for them. This was achieved through the use of a study journal, as well as assessment.. All modules need to make use of a dialogue stage, whereby students test their understanding of a concept against that of others. This is done through the use of computer conferencing. The course thus makes extensive use of conferences throughout the material.

The Study Model

One of the problems with any material which is studied at a distance is that of pacing. In order for students to gain the maximum benefit from the material they need to work through all of it, but when all of the material is available there can be a temptation to rush through it. In the traditional distance learning model this has been accommodated with regular mailings, timing of key events (such as assignment submission and so forth). Similarly distance education must deal with the issue of 'information overload'. Level 1 students may be studying for the first time, or returning to study after a long time. They thus need to be made to feel comfortable with the material, and what is required of them. These two considerations led us to develop the following study model, which is broadly analogous to the traditional model.

The web site is revealed as students progress through the course. As students have different demands on their time, it is necessary to make material available which is ahead of the current study schedule. Thus material is available up to four weeks ahead of where students are currently recommended to be. This pacing is reinforced through the use of study guides, which are e-mailed as an attachment to students every two weeks. These study guides provide a detailed breakdown of exactly what is required of students during the specified study period.

Assessment

The assessment of T171 is based around four tutor marked assignments (TMAs) and an end of course assessment. All of these are submitted electronically. The first two TMAs occur in module one and are based on collections of exercises students perform during the module. The last two TMAs occur at the ends of modules two and three, and are web-based reports which explore key issues raised during the modules.
The final assessment is based around a web site which students construct. There are two key components to this. The first is a portfolio of material produced during the course. This includes examples of the study journal, reflection on one TMA, conference messages and so forth. It thus represents a way of reinforcing the importance of these skills to students. The second component is a scenario based web site, which requires students to use material from all three modules, and with modules two and three in particular examine similarities and differences in the two stories. This encourages them to use new skills they will have developed such as writing for the web, page layout, website structure and use of links, rather than the more traditional essay type assessment.

Study Skills

As a Level 1 course within the OU, T171 has a role to perform in developing student's general study skills which will help them with any further study. As part of its aims to produce students, who are comfortable in using and dealing with the new technologies, it also needed to develop skills which would allow students to use computer tools effectively. Module one was based around a generic method of teaching, that is it was not specific to one software package. Students are thus provided with information and activities germane to all brands of the broad software type, e.g. spreadsheets. The skills developed are those of transferable ones between different software packages.
General study skills are developed in module two through the use of exercises in the material. These include skills such as note taking, critical reading, producing effective explanations and so on. The requirement of the end of course assessment is that students provide evidence of having completed at least some of these exercises. These exercises represent the traditional study skills which any Level 1 course has to address to some degree.
Skills which have not been developed in other courses, but which will become increasingly important for students are developed in module three. These include finding and evaluating information on the Internet, organising large amounts of information through the use of hyperlink documents, effective writing for the web, and so forth.

Conclusions

T171 was produced in one year, compared with the traditional production cycle of three to four years in the OU. It has proved extremely popular with a broad range of students, many of them new to the University. Estimated student numbers for 2000 are in excess of 5,000. It has managed to combine many of the successful elements of traditional OU course production with the benefits offered by the new technology.
The course uses a three stage learning model, which encourages students to engage with the learning material, and to discuss this in computer conferences. The course uses accessible set books as the basis for teaching and adds academic material to these in the form of a web site. Students are directed through this by means of explicit study guides. Their contact with their tutor is mainly through a tutor group conference.
A number of study skills, both new and traditional are developed through the use of exercises. These are reinforced by inclusion in an end of course assessment.
The advantages of this method of presentation are that it allows course teams to present up to date courses in a rapidly changing field. It gives students experience in using the new technologies, and allows them to access the material anywhere they can find an Internet connection. Problems of attendance at face to face tutorials are also removed by using online methods.
Alternative software methods are currently being investigated. A full scale evaluation of the tutor and student experience is being performed, which will influence alterations to the course material for presentation in 2000.

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SHORT PAPERS

WORKS-IN-PROGRESS

Teaching College English Classes On-line: One Instructor's Journey Through the Minefields of Ignorance

Julie R. Adams
Germanna Community College/University of Virginia
16341 Norman Rd.
Culpeper, VA 22701
adams@ns.gemlink.com

John V. Adams
Southside Virginia Community College
16341 Norman Rd.
Culpeper, VA 22701
svadamj@ns.gemlink.com

The magic lantern, film-strips, tape recorders, 16mm films, teaching machines, audio labs, television, video-discs, and teleconferencing have all, at one time or another, been touted as technologies that would have a significant impact on education (Saettler, 1990). The history of technology in education contains extensive documentation of the reasons why such innovations have failed or have had limited success. These reasons are as varied as the technologies themselves. However, there are common threads running through all of the attempts to transform education through the use of technology. The factors related to success or failure are well known and include administrative support and understanding of technology, teacher training, sufficient funds and release time, and effective technical and instructional support. Today the technology that is receiving the most attention is the computer. The question is, will this technology achieve the success that other high-profile innovations of the past have not?

This short paper on a work in progress responds to the lack of information about real-world situations where teachers are trying to apply computer technology in instruction. It is based on a case study that documents the experiences of Dr. John Adams, a community college English instructor, who, over a period of five years, progressed from teaching composition in a computer laboratory setting to teaching seven classes on-line. It is a record of the experiences that he had dealing with the challenges of applying computer technology in his classes with little administrative support, almost no training, little technical or instructional support, and no release time or financial assistance -- the same factors that limited the success of previous educational technologies.

In the 1993-94 semester, his first at his present position, Adams was asked by his division chair to teach one class each semester in a computer lab. The lab contained 24 PC's placed on regular straight tables arranged in four rows with six computers to a row. The computer screens were facing away from Adams (i.e., not visible to Adams); the room was also used for storing discarded miscellany from other rooms. For his classes, Adams used the tools (handouts, reading book, test/quizzes, etc.) and methods (lecturing, answering questions, grading papers outside of class) that he used in the traditional classroom. Adams expressed a high degree of frustration with the computer lab setup. He felt that it was a major hindrance to communicating with the students, and he missed the conferencing orientation that he was accustomed to in his other classes.

In the fall of 1996, Adams began putting his course materials on the Internet, with the assistance of his wife. These initial materials were copies of the ones he was using in his classes. Then, in the fall of 1997, Adams negotiated with representatives of Old Dominion University's Teletechnet program to teach advanced composition on the Internet. For this class, he not only had to create a completely new course (for him), but one that was appropriate for on-line use. In addition, that same semester, he gave his freshman composition students the alternative of being taught in a traditional classroom setting or via the Internet (with an option for one class meeting per week). Most students opted for the Internet-based course. Teaching these courses on the Internet involved revising old materials, creating new materials, and getting everything organized effectively and put on the Internet. It also required Adams to develop a new method of dealing with students, students whom, for the most part, he never met face-to-face. And it meant learning different organizational skills to keep track of the e-mail messages that he was receiving from his students.

With the 1998 summer session, Adams taught all four of his classes via the Internet only. This included one section each of college composition I, college composition II, advanced composition, and short fiction. The first three courses required a number of revisions and additions to the course websites to make them effective as Internet-only courses. For the short fiction course, however, Adams had to create and organize a completely new set of materials to be put on the Internet. During the fall 1998 and spring 1999 semesters, Adams taught seven sections of courses on-line. These included the same four classes that he had taught during the summer as well as African-American Literature I (fall 1998) & II (spring 1999) and a technical writing course (both semesters). Once again, for these three new courses, Adams had to create and organize the materials and assist his wife in the process of creating the webpages for the course websites.

Administrative support is a critical element to the success of any academic endeavor. In Adams' situation, this support has been negligible. The first semester that Adams taught in the computer lab, he felt that the administrative position was, in essence, "There's the lab. Use it." As long as there were no complaints from students, the administration seemed to be satisfied. Over the course of several years, the administration continued to request that Adams use the computer lab for classes, but they expressed a strong opposition to Internet classes. Adams felt that this opposition was based in part on the assumption that students could only receive a quality education in the classroom. Adams felt that another factor was a lack of knowledge about computers on the part of top-level administrators. Until the fall of 1997, none of them had a computer on their desks, and, as a result, they had a limited understanding of how computers operate or of the potential of computers in education. Because of their opposition to Internet courses, Adams established his Internet classes surreptitiously, with only spoken approval from his division chair. Not until the summer of 1998, with very positive enrollment results from his on-line classes, did they begin to publicly state their acceptance of such courses.

Technical and instructional support is also critical to the effective application of educational technology. Unfortunately, this has been lacking in Adams' experience. During the semesters that he was teaching in the computer lab, technical support was minimal, just basic maintenance. When he moved to Internet classes, the situation did not improve. While the technician on staff has the qualifications to handle the responsibilities of computer maintenance and those of web master, he does not have a background in education. As such, he is unable to provide effective instructional support on the applications of computer technology.

Adams has received neither release time nor financial assistance from his college for his work related to the application of computers in his instruction. Since the fall of 1996, Adams has developed materials for seven on-line courses, and with his wife's assistance, has created and updated a comprehensive website with these materials and links to other resources. Adams purchased his own laptop computer and zip drive because of problems with his office computer (it could not handle the workload and broke down; after it was fixed, it was given to another instructor). He also purchased critical software and instructional manuals.

Year after year, the literature on instructional technology has documented the problems and has provided the solutions. However, in the real world of education, the problems are often not recognized by the people in positions of authority and, thus, the appropriate solutions are not applied. At the end of one interview, Adams commented that, in his present situation, he spends all of his time maintaining what he has developed so far, and that he has no time to keep up with new advances in technology. As a result, he feels he that is actually falling behind rather than progressing. Unless there is sufficient administrative support, adequate teacher training, effective technical and instructional support, and appropriate compensation through release time and financial assistance, those who are trying to advance the effective use of computer technology in education will also find themselves falling behind rather than progressing.

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Practical & Low Cost Methodology for Internet Classroom Presentations

Kenneth J. Ekegren, P.E.
Engineering Technology Division
North Central Technical College
Mansfield, Ohio U.S.A
kekegren@nctc.tec.oh.us

Introduction

Current technology is now available that can remove the restriction of time from the delivery of classroom lectures. By utilizing Microsoft's PowerPoint software along with RealNetwork's RealPresenter plug-in, any school can easily provide a low cost, efficient way to offer recorded lectures over the Internet. With the emphasis on life long learning and the increase in non-traditional students in classrooms, Internet accessible lectures let students "attend" a class lecture that they may have missed due to shift change, unexpected overtime, or an out-of-town business trip. This gives them the flexibility to listen to any recorded lecture at their convenience, from a computer lab on campus or from any Internet accessible computer.

The Web Enhanced Audio System

During Winter Quarter, 1999, North Central Technical College offered recorded lectures from seven different courses using the Web Enhanced Audio System. Using conventional portable audio tape recorders, lectures were recorded and then processed through a computer into single-slide, PowerPoint presentations, with up to one hour of lecture embedded into the slide. NCTC already had a standard web server and network on campus and were also using Microsoft's Office 97 software. Adding to this, the College purchased RealPresenter software ($39) and a number of portable audiocassette recorders ($50 each). The only other hardware used was an audio cassette player for playback into the computer ($70). With an outlay of less than $500, the school was able to offer asynchronous delivery of course material via the Internet.

There seems to be two major roadblocks that hinder the development of Internet accessible course material: time and money. This Web Enhanced Audio System was designed to overcome these two obstacles. The nominal amount of hardware required, assuming a school has an existing web server and Office 97 software, eliminates the financial portion of the problem. And the other roadblock is finding the time and expertise to create or develop web accessible material. The Web Enhanced Audio System solves this by not requiring instructors to have computer expertise, nor burdening them with additional class preparation, aside from wearing a recorder during class. A web course coordinator can perform all of the processing and must simply have a working knowledge of PowerPoint and be familiar with standard audio equipment.

The Process

Once a lecture is recorded, it is sent to the web course coordinator and downloaded into a one-slide PowerPoint presentation using the "Record Narration" function. The single slide identifies the course number, date, and lecture subject. The software captures the audio lecture as large wave file (up to 70 megabytes for a typical one-hour lecture). The RealPresenter plug-in software then compresses the lecture (about 2 megabytes per lecture) and creates a web page suitable for publishing onto a standard server. A Table of Contents web page is created for each course and linked to the instructor's home page. The Table is then updated with the addition of each new lecture, acting as a directory for locating class meetings by date. To access a lecture, the students simply go to their instructor's web page, click the appropriate audio course button, and select the date of the desired lecture. Students can access their lectures from any campus computer lab by plugging head phones into the computer speakers, or from their own home, at their convenience.

Benefits

There are many benefits to this Web Enhanced Audio System. The low start-up cost in hardware and software for any college that already has a website makes this system possible without causing a major impact on the budget. The level of expertise for instructors is limited to the ability to push the record button on a portable tape recorder. The level of expertise for the Web Course Coordinator is limited to knowledge in PowerPoint software, simple web page creation and revision, and some audio equipment expertise. In addition, the impact on the web server and network infrastructure is minor due to the gradual increase of storage requirements and activity as the quarter progresses. And the benefit to students is the removal of thc time barrier associated with traditional class schedules. Plus, they can use this material for review purposes as well.

New Advances

One drawback to this system had been the slow download time found with traditional audio tape recording media. With the availability of new portable digital recorders, even the transfer of recorded media has been reduced for a "real time" 45-minute lecture down to about 4 minutes. Digital recorders are now available that can record up to two hours on a flash memory card, which can be handled like any other electronic file, and can be converted into a wave file in a matter of minutes.

The level of web enhanced lecture can also be upgraded by adding pictures or text to the web pages to be seen during the lecture. In addition, instructors already using PowerPoint slide shows during class can include the entire slide show, time-encoded so that it appears on the web just like it was given in class. The software used in this system could even be used to embed video of a process or procedure into the slide show if desired.

Conclusion

The Web Enhanced Audio System is a practical and low cost method of placing lecture material onto the Web. Using cutting edge tools that are inexpensive, coupled with a technique that is time efficient and extremely user friendly, any school can develop a web presence without the typical obstacles associated with new ventures. The Web Enhanced Audio System can also be used to augment independent study courses and can become the first step in developing complete online courses at any college. The insignificant impact on faculty's time and the low hardware cost make it a practical and economical method of converting and delivering lecture material over the Internet.

Developing Reading and Writing: Learning About Literacy in a Virtual Environment

Viv Ellis, School of Education, University of Brighton, UK <v.ellis@bton.ac.uk>

Simon Shurville, School of Languages, University of Brighton, UK <sjs16@itri.bton.ac.uk>

This paper outlines the context and rationale for a piece of curriculum development at the University of Brighton which is also the site for collaborative research by a teacher educator and a learning technologist. The development relates to 'Developing Reading and Writing,' a first year module on an English education degree for intending high school English teachers.

The aims of the module are: i. to investigate literacy as a sociocultural practice; ii. to investigate the ways in which technology changes both the nature of text and the ways texts are produced; and iii. to explore the pedagogical possibilities that would enable high school teachers of English to use digital technologies to enhance pupils' learning. The context for the development includes a commitment to a pre-existing and successful model of a learning environment for English/Language Arts education shared by the development team and the recent curriculum prescription contained in the UK Department for Education and Employment's Initial Teacher Training National Curricula in Secondary English and the use of Information and Communications Technology (DfEE 1998). The current development is an evolution of previous work at the university and not a reaction to this prescription. The aims of 'Developing Reading and Writing' have remained consistent for the last two years.

The shared model of a learning environment for English/Language Arts can best be described with the metaphor of the *atelier*, a place for *artisanal* activity. This metaphor was explored by one of the authors in previous collaborative work with Claire Woods and Patrick Dias (Woods et al. 1996) and, in relation to learning about literacy, is useful in conveying a sense of a shared purpose and of the dependence and interdependence of the *artisans* who work within it. The metaphor of the *atelier* allows for notions of expertise in a learning environment, expertise that is shifting and dynamic between teacher and students. It suggests the assumption of responsibility on the part of the learner. It also assumes that experience - read and lived - can be 'crafted' by language.

An important implication of the use of this model for learning about literacy is the positioning of learners as 'ethnographers of their own situations.' This is not to say that students spend much time talking about ethnographic research but they do talk about key terms and, in view of the module's aim to examine literacy as a sociocultural practice, they are encouraged to refer to the work of some of the more celebrated ethnographers of literacy such as Brian Street (Street 1992). This is not a research methods module, however, so what exactly does the phrase 'ethnographers of their own situations' mean? Woods et al. suggested that this involves positioning students as observers and researchers of contexts, recording data and observations and making decisions about the selection of details, leading students to a critical experiencing of texts, contexts and discourses (Woods et al. 1996: 12). This was our aim in immersing our students in the digital literacy practices of the internet and its associated technologies.

As resources for internet-based learning in UK higher education evolved in the political climate following the comprehensive review of higher education provision conducted by Lord Dearing, it became possible to extend the 'on-line' dimension of this module in line with current theory in computer-assisted learning. We decided to embed an existing on-line discussion forum within a World Wide Web environment which provides contextualised access to the technologies associated with the face-to-face 'classes'. In line with theories of constructivist internet-based learning (see, for example, Laurillard 1998), the module's web-based environment contains: home-produced materials, suggested links to external materials and search engines which enable students to seek authentic materials on the net. There are also synchronous and asynchronous forms of communications technologies embedded in the site.

As part of the curriculum development process, and at the beginning of the academic year, we conducted a questionnaire survey with the cohort of students who were to take the module in the second semester. Our questionnaire revealed a cohort in their late teens and early twenties with very limited skills in Information and Communications Technology. This finding influenced a number of design choices.

Firstly, in terms of genre, we chose to present the environment as an on-line magazine with one 'story' each week surrounded by links to resources, tools and activities. Second, the navigation of the site was initially made very linear. This was to support the skills development of the students with the intention that the navigation would become increasingly heterogeneous with external linking via 'spin-off' windows. Third, among the tools available would be on-line instructions for synchronous and asynchronous conferencing, an archive of previous 'stories', additional readings and the facility for students to publish their own texts on the site. Through the use of various 'seed' questions dispersed throughout the site, we invited the students to comment on all aspects of the design of the environment in the discussion forum and to speculate on the pedagogic reasons for these design choices. This was one aspect of positioning students as ethnographers. Others include immersing the students in the texts, contexts and discourses of fantasy role-playing MOOs.

In line with our concerns about hype and the new technnologies, our environment is being critically evaluated with our students. Their reactions will be reported and used to refine our subsequent approach to learning about literacy in a virtual environment.

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"Electronic Commerce Course in Business: Using Collaborative Hypermedia-Based Learning Experiences"

Rebecca Angeles, Ph.D.
Information & Decision Sciences Dept.
School of Business
Montclair State University
Upper Montclair, New Jersey 07043, USA
Email: hendonr@mail.montclair.edu

Dennis M. Adams, Ph.D.
Reading & Educational Media Dept.
College of Education & Social Services
Montclair State University
Upper Montclair, New Jersey 077043, USA
Email: adamsd@saturn.montclair.edu

Opportunities for Collaborative Learning

The opening of the Internet and the World Wide Web (WWW) to businesses has introduced an entirely new specialized area in Management Information Systems (MIS) called Electronic Commerce (EC). This paper illustrates how EC provides rich pedagogical possibilities for collaborative learning using hypermedia, active learning by doing, and constructivist teaching approaches. Selected universities in the country introduced EC courses in their MIS programs to address new developments taking place in the Internet-enabled marketspace. Content analysis of the course materials put out on the WWW by these selected universities in the ISWorldNet Web site was the primary technique used in writing this paper. Kosiur (1997) defines EC as "...a system that includes not only those transactions that center on buying and selling goods and services to directly generate revenue, but also those transactions that support revenue generation such as..offering sales support and customer service, or facilitating communications between business partners."

The technological platform for conducting EC in the marketplace could also be used for student instruction in recreating business Web sites. This is perhaps one of the course's primary strengths. Furthermore, it lends itself to the pedagogy of collaborative learning where student teams take an active role in constructing the knowledge they gain. Research is clearly supporting the efficacy of this technique in effectively engaging student attention and energies. In a cooperative learning environment, the instructor organizes content and topical activities around tasks, problems, and projects that student teams with a balanced mix of abilities and backgrounds are designed to undertake (Adams and Hamm, 1998). Team members' social skills, also called "interpersonal intelligence" according to Howard Gardner, encompassing interpersonal communication, task management, group interaction, and conflict resolution are constantly honed throughout the process.

Class Activities

The first set of activities involves a cognitive appreciation of the potential of EC for generating innovative Web-based products and services: assembling Web-based business plans used to justify potential online businesses; designing small business Web sites; writing reports on such topics as EC technologies or industries that lend themselves well to EC; doing case analysis on firms pioneering the use of the WWW; creating Web pages with a variety of content, and undertaking Internet activities. All these activities are to be conducted within a context that is meaningful to the student and one that builds on their specific business major, prior experience, and knowledge following the constructivist pedagogical approach as opposed to the traditional objectivist method (Cheek, 1992). Students will be asked to choose topics to explore and practical hands-on projects that most directly connect to their line of work in the office or personal interests.

Learning by Doing

"The yeast of knowledge, openness, and enterprise raises the need for a multiplicity of learning media and technological tools "(Adams and Hamm, 1996). The very wealth of Web site building tools that is now available allows students to experiment and "play" through "learning by doing" activities and significantly changes the whole instructional experience. Students have more control over the end product via the software tools and they assume greater responsibility over their learning process (Adams and Hamm, 1996). The "standard" activity for the beginner-level EC course is having students build small business Web sites using publishing software like HTML editors, Netscape Composer; Microsoft Publisher 98, FrontPage Express, or FrontPage 98; Cold Fusion; and other such tools. Web site design issues appear to be the emphasis of courses at this level. Courses for the more advanced EC course could look into Web site features that facilitate the actual sale transaction. Thus, students may be asked to perform more advanced E-Commerce activities like developing online order entry forms that actually accept data at the backend via a database package using tools like Symantec's Visual Café employing visual programming. Another small project is using CGI scripts for writing shopping cart application consisting of an item catalog interface, item description pages, and a main checkout page. There are Web sites such as those of Data Transfer Associates, Inc. (http://www.dtastore.com) and iCat (http://www.iCat.com) where demo software is available so that students can experience building online retail stores and act like online merchants. Both companies allow students to build prototype online stores. The site is customized so that it reflects the store owner's name, products sold, their descriptions, prices, and code numbers. The store is set up so that there are different departments showing the appropriate product line. An online shopper goes through these departments, chooses products to buy, and then, checks out desired items. The service also makes the online merchant capable of processing shipping and billing and credit card information. The server of Data Transfer Associates runs tests to verify customer addresses and check credit card approvals using CyberCash, Secure Socket Layer (SSL), and other technologies.

Students could also be asked to enhance their business Web sites by adding features that promote a "virtual community" using software packages like VirtualSuburbia (http://www.virtualsuburbia.com). Hagel and Armstrong (1997) define "virtual communities" as online communities allowing customers with the same interests to congregate, create content, and communicate on an ongoing basis. VirtualSuburbia allows students to create a collaborative environment for groups of people by allowing them to chat online and to show any Web location in the world for comment and evaluation.

Perhaps, the greatest strength of the EC course activities is that they lend themselves to authentic student learning assessment using the portfolio approach (Adams and Hamm, 1998). Since the course will be heavily project- and activity-based, outcomes of student learning are constantly being produced and collected. There are even a few instances in these courses where student teams actually went into business using their pilot projects for the course. This is, perhaps, the best measure of course success even though it is rare.

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Instructional Applications of Information Architecture

Stephen P. Victor
BMC Software, Inc.
2101 CityWest Blvd.
Houston, TX 77042 USA
Email: svictor@bmc.com

It is commonly stated that we live in an age of "information overload." Increasingly advanced communication tools, including the Internet and digital telecommunication technologies, allow us to transmit more and more information at faster and faster rates. A discipline—known variously as information design or information architecture—has evolved to meet the challenge of using information to provide meaningful communication. The discipline embraces such diverse fields as business administration, computer science, cognitive psychology, graphic and typographic design, and technical communication.

Information architecture is the structuring of data to meet the informational and management requirements of an organization or group of people. For example, in their work on designing web sites, Rosenfeld and Morville (1998) state that the information architect is responsible for clarifying the mission and vision of a web site; for determining the site's content and functionality; for specifying how users will find information by defining the site's organization, navigation, labeling, and searching systems; and for mapping how the site will change and grow over time (Rosenfeld & Morville, 1998, p. 11).

This paper briefly examines some theoretical underpinnings of information architecture, considers the application of the principles of information architecture to instructional theory and practice, and describes ongoing research to evaluate the efficacy of such an application.

Theoretical Background

Information Theory

Building on the seminal work of Shannon (1948), information and communication theorists have proposed a model that describes the transmission of information from source to recipient. Current information theory is concerned primarily with the binary coding of transmitted messages in ways that minimize "noise" (Ash, 1965; Gallager, 1968). Information designers have drawn on the theory to suggest that information be designed in ways that reduce confusion and enhance the transmission of meaning to the recipient of the information (Senechal, 1997).

Perception and Cognition

Stern and Robinson (1994) define perception as the gathering of information through the senses and the organizing of that information to create meaning. All sorts of factors—such as personal characteristics, past experiences, and present feelings—can influence how sensory information is interpreted. Kosslyn and Chabris (1993) demonstrate the use of principles of cognitive psychology to improve the effectiveness of informational graphics, such as charts and graphs. With an understanding of cognitive principles, the designer can create graphics that influence how viewers will perceive graphical elements and the meaning of the relations of those elements to each other.

The Social Construction of Knowledge

Vygotsky and others have suggested that knowledge is socially constructed: a conversion of social relations into psychological functions (Driscoll, 1994, p. 229). Learning takes place as learners are moved, through social interaction with more advanced peers and adults, to higher levels of development.

Constructing an Information Architecture

The literature suggests the following guidelines for designing an information architecture:

- Center the process on the needs of the users of the information.
- Perform a structured user task analysis to determine the user's information requirements.
- Involve users at all stages: analysis, design, and implementation.
- Map specific information needs to information elements in the web site or instructional piece.
- Structure information so that meaning is conveyed effectively. Consider whether design elements could detract from meaning without providing some benefit such as increasing motivation.
- Organize information so that the user can easily find it. Create labeling and navigational systems that are logical, consistent, and easy to use.
- Organize information in ways that facilitate the user's learning and schema creation.
- Consider personal or cultural factors that might affect perception of information.
- As ideas take shape, create storyboards, mockups, and flowcharts. Eventually, map the entire site with detailed architectural blueprints.

Instructional Applications: Ongoing Research

Proponents of constructivism state that learners construct their own knowledge in ways that are personally meaningful. Some constructivists also suggest that the constructivist instructor guides learners to integrate their personally-constructed knowledge into the larger body of socially-constructed knowledge. I suggest that instructors can use information architecture to allow students to structure their learning in ways that foster their own construction of meaning.

To evaluate my suggestion, I have designed a class entitled "The Instructional Applications of Information Architecture." The class will be offered to graduate students in the Curriculum and Instruction department (Instructional Technology concentration area) at the University of Houston, and I will co-teach the class with Dr. Sara McNeil. The expected population will be mature graduate students who are conversant with computer and Internet technology. At or near the beginning of the term, we will conduct an exercise in which students will map the types of learning they wish to achieve. Students will map out the instructional sequence and build an information architecture for the course using the guidelines listed above. This architecture will be collaboratively negotiated by instructors and students. Using a web site management program, such as Microsoft FrontPage or Adobe PageMill, students will create the basic architecture of the course. As the term proceeds, students will flesh out the web site with articles, assignments, and projects. At the conclusion of the course, I suggest, students will have designed and completed an information architecture that gives tangible form to the cognitive maps they have built.

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The PASSENGER CSCL Tool for Distributed Learning in a Multimedia Environment

Axel Hunger, Frank Schwarz, Stefan Werner
Gerhard Mercator University of Duisburg
Department of Data Processing
Germany
Swerner@uni-duisburg.de

Introduction

Nowadays, a new component is added to the complex task of industrial Software-Engineering: the development in worldwide distributed teams. This paper describes new concepts and tools based on this scenario that are developed for the Software-Engineering-Education. This tools give the students the ability of shortening their study-time, but also they have the chance of obtaining knowledge in systems known as Compuer Supported Collaborative Working (CSCW) Environments (Kremar, in Salvendy, Smith, 1991).The practical training aims at applying subject matters which were imparted in the lecture in a realistic scenario. During the semester the teams will experience the entire life cycle of Software-Engineering. Problems given in the past were amongst others simulating an elevator control for a high-rise or the simulation of a car-production-plant.

The Passenger Concept

The organization of the Software Engineering lab is supposed to be extended by aspects of distributed teams in the future. This scenario has long become reality in the Software-Engineering industry and is well-known in the literature (Nakatani, Nishida and Takeda, in Salvendy, Smith, 1991). Following this scenario, the Passenger-Concept defines four modules for the conduction of the Software-Engineering course. In this paper we will focus on the development of the Passenger Case & Video Tool. A description of the other modules can be found in (Hunger and Werner, in Gil-Mendieta, Hamza, 1998).

The implementation of the concept requires efficient CSCL-tools to transfer the knowledge of the lecture and to conduct the practical training in a distributed manner. A condition for conducting the practical training is the availability of tools for a synchronous communication and for common document processing. Altogether the following modules have to be realized:

1. Synchronous communication tools for text, audio and video.
2. A session handling to control the synchronous sessions.
3. Protocol stacks to meet the required network services.
4. A Software-Engineering-Case-Tool for common document processing.
5. A control system to handle different kinds of permissions.
6. A version control system for the common documents.

Commercial available videoconference tools do not offer all of the above mentioned functions. Therefore those tools can not be considered for the conduction of the practical training.

The scenario of distributed Software-Engineering places additional demands on the students. Apart from learning the actual contents and how to work in a team, the following three aspects will lead to a steeper learning curve.

1) The students are not used to applying Software-Engineering Case-Tools (Boloix, G. & Robillard, P.N., in IEEE, 1998).
2) For the students, discussing by the means of video conferencing represents a completely new form of communication (Hunger & Werner, in Verbraeck, Al-Akaidi, 1998).
3) Common document processing over a network is new to the students.

The Passenger Case & Video concept sees windows based systems as its target platform and the global internet as its transport medium. For the clients a multimedia data interface represents the interface to the input and output peripherals like keyboard, mouse, video camera, speaker and monitor. A Case-Tool is used for common software development. During the conceptional considerations of the Passenger-System-Architecture, different possibilities for the data transfer were discussed. As a result of the discussion several methods of data transfer have been implemented: several unicast-connections for client/server-communications and several multicast-connections for interclient-communications.

The requirements which individual connections place upon a service are: Client/Server connections require reliable services, inter-client connections on the other hand only require unreliable services, but a guaranteed bandwidth and delay. In order to achieve these guaranteed quality-of-service we make use of resource reservation. In a first step a protocol stack based on the Internet Protocol Version 6 (Deering & Hinden, 1998) for the realisation of multicast connections in the Internet, associated with the Resource ReSerVation Protocol (RSVP) (Braden, Zhang, Berson, Herzog, Jamin, 1997) for quality-of-service support is developed. Measures to increase performance arise in this first step by strictly splitting the connection types in reliable and unreliable services and implement them in several parallel protocol stacks. Measures like adapting certain protocols should be considered later.

Summary and Outlook

This paper presented a new concept concerning the University-Education on the subject Software-Engineering. Based on this concept new tools were developed and implemented. The essential innovations of the presented idea in comparison with known concepts are in this case the integration of different tools under a common user interface, the way in which face-to-face discussions are taken into account, the development and integration of case tools especially for the usage in a practical training and the assembly of parallel protocol stacks with usage of given protocol structures.

The first version of the communication tools is expected during the summer of 1999. Concerning the practical training of Software-Engineering, the tools are supposed to be put into practice during the summer-semester 2000

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Discovering Science: a Distance-Learning Course with Integrated Interactive Multimedia

Stuart Freake
Faculty of Science
The Open University
United Kingdom
s.m.freake@open.ac.uk

Introduction

Discovering Science is a new introductory science course from the Open University (OU) that makes extensive use of interactive multimedia activities on CD-ROM (The Open University 1998). It was first presented in 1998 to over 3000 students in the UK and Western Europe, and is the first OU science course that requires students to have access to a computer in their homes. 25 CD-ROM activities were produced, requiring about 40 hours of study time, making this the largest single educational multimedia project in the world. This paper outlines the scope of these materials, how they are integrated with the course, and some issues arising from their production and presentation.

The CD-ROM Materials

The role of the CD-ROM activities is to teach science, and the range of topics reflects the scope of the course, which covers aspects of biology, chemistry, Earth science, physics and astronomy. Activities include:

- an interactive computer model of the Earth's atmosphere that allows students to modify factors such as the carbon dioxide level or the cloud cover and to investigate the effects of these changes on the global temperature;
- a virtual field trip to the Galapagos Islands, following in the footsteps of Charles Darwin, to investigate adaptation, speciation and evolution; and a virtual trip in a submersible to explore the Mid Atlantic Ridge;
- use of molecular viewer software to visualize the 3D structure of molecules, ranging from the simple methane molecule to complex proteins;
- interactive maps and models that are used to investigate past and future motion of the Earth's tectonic plates;
- a virtual telescope, used to determine the distances and speeds of galaxies, and hence the age of the Universe.

All of these CD-ROM materials are highly interactive and they make use of the ability of a multimedia computer to present a mix of video, audio, computer simulation, graphics, text, questions, etc. They are integrated with the other distance-learning components of the course, which include 11 books (1300 pages), a loose-leaf study file (500 pages), five hours of video material, ten half hour TV programmes transmitted by the BBC, a small home practical kit, and a one-week residential school.

Production of the CD-ROM Materials

This was the first major venture into production of interactive multimedia CD-ROMs for teaching by the Open University. Many lessons were learnt, and a few of these are outlined here.

- There were long discussions about whether to use an existing interface/shell/navigation system, or whether to develop a system of our own for use with all packages. We eventually decided that both of these routes would restrict the scope and variety of the materials that we wanted to produce. Broad guidelines for the interfaces were drawn up, but these guidelines were interpreted quite flexibly, so the different activities have very different looks and feels.
- With 25 CD-ROM activities (plus CAL software for developing mathematics skills, and interactive self-assessment questions covering the whole of the course), it was essential to devise a simple way for students to access the computer-based material. We developed so-called CD-ROM Guides that students installed on their hard drive, and these not only made it very straightforward to access each of the activities but also helped to integrate the different CD-ROM activities with the rest of the course.
- Production of alpha versions of some CD-ROM activities used most of the time and resources that had been allocated for completing the activities, leaving limited scope to make changes following developmental testing. In future projects we will ensure that 30% of the time and resource are held back for revisions following testing of the alpha version of the software.

• OU students' computers have a wide range of hardware specifications, they are configured in a variety of ways, and they are running many different software applications. We had to find a compromise between producing state-of-the-art multimedia software, which would only run successfully on high-specification machines, and producing software that would run on low-specification machines but which would look and feel rather dated. The software went through thorough QA testing on a range of machines, but even so a small proportion of the thousands of students who used it experienced problems. Our telephone helpdesk sorted out many of these problems, though some required changes to CD-ROMs that could only be made for the second year of the course.

Studying CD-ROM Material

Surveys of students and tutors highlighted a number of issues relating to use of the CD-ROM materials.

- Most students enjoyed studying the CD-ROM material, and found it interesting and motivating.
- Studying CD-ROM material is very different from studying text, watching a video or listening to a lecture, and many students found it more difficult to learn from the CD-ROM material. Students have little experience of learning from CD-ROM, and they need advice about note taking and time management in particular.
- Students like to be able to browse freely through a CD-ROM activity, to dip into it at any point, and to move backwards through an activity as well as forwards, just as they can with a book. Some of our CD-ROM activities constrained students' freedom of navigation, and were criticized by students and tutors for this reason.
- The ability to specify where you are in a CD-ROM activity is extremely useful, particularly when you are remote from a person with whom you want to discuss the activity, e.g. your course tutor. Page/screen numbers are far more convenient than specifying 'the third screen after the second question in part three'.
- We integrated the CD-ROM material with the other components of the course, so that students wouldn't perceive it as an optional extra. However, some topics were only covered in CD-ROM activities, and it was then necessary to emphasize the importance and relevance of these activities. Assignment questions and exam questions were an effective way of doing this.

Ongoing Evaluation

Student surveys in 1998 concentrated on identifying any problems that students had with using the CD-ROM material, but further evaluation is now underway. One survey is investigating how students study CD-ROM material and how their study methods correlate with their learning style, as determined by responses to an 'Approaches to Study Inventory'. It is clear from data obtained in the first year that a small proportion of students dislike using this medium and had difficulty learning effectively with it. Information from this survey should help us produce advice for distance-learning students about developing appropriate learning strategies.

A second survey is investigating cognitive gain from these CD-ROM activities, and the dependence of this on the level of interactivity in the activities. Our assumption is that interactivity promotes effective learning, and we will test this hypothesis in this study, and compare cognitive gains from different types of interactivity.

Conclusion

The CD-ROM activities produced for *Discovering Science* demonstrated some of the benefits of incorporating interactive multimedia activities in introductory science courses. The lessons learnt during production and presentation of this course will feed through into the production of CD-ROM material that the Open University is now producing for its future science courses.

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Acknowledgement

The CD-ROM activities for *Discovering Science* were produced by a large multidisciplinary course team, which included staff from the Open University Science Faculty, Academic Computing Service, Design Studio and Institute of Educational Technology, and from the OU BBC Production Centre.

Discovering Science – with Interactive Multimedia CD-ROMs

Stuart Freake
Faculty of Science
The Open University
United Kingdom
s.m.freake@open.ac.uk

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The poster and demonstration highlight:

- the wide range of styles used: game format; resource-based free exploration; linearly structured CAL; virtual experiments and virtual field trips; etc;
- the wide range of topics: global warming; evolution; quantum physics and cosmology, cell biochemistry; etc;
- the integration of CD-ROM material with other course components;
- the CD-ROM Guides that are used to access the CD-ROM material.

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VRML in Education: a user's perspective on the potential for instruction and exploration.

Scott M. Graves
John C. Davis
Institute for Mathematics, Instructional Technologies and Science
College of Education
University of Idaho
United States
sgraves@uidaho.edu
jcdavis@uidaho.edu

INTRODUCTION

With the rapid evolution of Internet technologies, and the advent of WEB TV and hybrid cable/modem systems that promise ever-increasing data throughput, Virtual Reality Modeling Language (VRML), is rapidly approaching viability as a medium for educational program delivery and interactive learning. As the industry furthers its resolve on standards for VRML, a few stepwise approaches to VR for exploring virtual learning environments are being embraced and utilized by creative netizens. Apple computer's QuickTime VR "virtual panorama and virtual objects" technology is an intriguing step in the right direction, and offers VR learning on the halfshell, sort of. There are hundreds of websites employing QTVR already; from Apple's Store, to The Wrinkle in Time Project's "day in the life" global simultaneous QTVR galley, to numerous online catalogs portraying virtual (rotate-able) sale items, etc.... But what are the uses for this VR steppingstone technology for education? Or for that matter, what educational use VR in general?

VIRTUAL REALITY MODELING LANGUAGE: *ROOTS*

Virtual Reality Modeling Language (VRML, commonly called "vermel") is an evolving Internet and web-based scene description language. Since its inception in 1994, VRML has been an open standard. In August of 1996 the VRML Consortium Working Group (CWG) was formed following a meeting at the AMC SIGGRAPH annual convention, and in 1997 the Consortiums' efforts to continue honing VRML, increasing its capabilities and streamlining protocols resulted in the present incarnation specification VRML '97. <http://www.vrml.org/>

Like its hypertext sibling, (HTML), VRML comprises a scripting strategy for describing the layout or arrangement of objects in a virtual environment; scene descriptors which in most cases are formulas for geometric solids, lines and planes, and scene metadata, as well as applied surface textures. Unlike HTML pages VRML documents describe a virtual space or three dimensional (3D) environment in which objects are located and around and through which the user can navigate by pointing and clicking, dragging and rotating or engaging controls on a navigation bar. In other words, VRML instructs a user's computer in how to arrange a file's contents in the web browser window, but that window is *really a window* or portal into a 3D space not just a flat surface on which text and graphics are situated. VRML works because relatively simple geometric shapes can often approximate fairly complex objects with textures mapped onto their surfaces, like wallpapering a simple box to simulate a fully decorated room. Once the size and shape of basic objects along with simple texture maps is downloaded, the browser builds those objects in 3D space locally. Moving around in the virtual space is then just a matter of the local computer reshaping and changing the relative positioning of objects to match changing perspectives of the viewer. All or most of the data is already passed off to the local machine for rendering, so individual scenes can hold many possible perspectives, and new information is retrieved only when needed to render as yet unseen areas of the 3D environment, or ever closer detail in an object.

The computer script and code of VRML is still evolving and as with HTML, SHTML DHTML, and XML, enhancements and additions to the standard are being proposed continuously. The first efforts to standardize a description of VR environments for the web took place at an adhoc meeting in the spring of '94 at the first International WWW Conference in Geneva, Switzerland. Shortly thereafter a www-VRML mailing list was opened and a draft version of the specification for VRML was collectively and collaboratively produced for the Fall 1994 WWW Conference (Pesce, 1994). Over a thousand individuals, researchers, technicians and users remain on this and other related www-VRML mailing lists.

VRML's roots are deeply entwined in the 3D design and architecture world, and the emergent "modeling language" may be described as only a recent means of streamlining scene layout descriptions for distributing those worlds on a network. The roots of "Virtual Reality" can be traced to the spatial design and rendering work of Ivan Sutherland and others in the late '60s (Sutherland, 1965). Numerous issues of the Association for Computing Machinery's Special Interest Group on Graphics (ACM SIGGRAPH) have been devoted to VR and visualization. Conn, Lanier, and others (1989) describe the future of virtual environments and interactivity on the Internet as an exciting and powerful opportunity for communication, collaboration and participation that will play a significant part of our future.

A perpetual challenge for VR and VRML is in the rendering and display of increasingly detailed and rich environments. Scene detail is highly dependent upon the computer's ability to quickly describe geometric primitives (or polygons), and arrange, highlight and render them with enough speed to permit successive adjustments and differing perspectives of the described world every few fractions of a second. As complexity in a scene builds, e.g. landscape details, increasing numbers of objects in view, and degrees of transparency and reflectivity, rendering times of individual scenes often cause even the fastest of PCs to grind to a halt. Effective VRML scene navigation depends on available RAM, VRAM and clockspeed of the viewing computer and the speed and bandwidth of the connection through which scene parameters and object descriptions are transmitted. Addressing this limitation, ongoing negotiations among Cable TV signal carriers and Internet providers, and a new incarnation of WEB TV devices and hybrid cable/modems may soon make a variety of virtual experiences more widely available than otherwise possible (solving part of the bandwidth and throughput problem).

VRML FOR EDUCATION

Aside from simulated military missions and video games (a common and very well institutionalized use of virtual reality technologies), VR "worlds", broadcast over the Internet have many potential uses in instructional and educational settings. VR is showing outstanding promise for teaching, demonstrating and learning in the medical profession, in the engineering and structural design fields, as well as in projects where "being there" is all but impossible.

VRML in education will likely find utility as a means of exploring complex mathematical "terraines", giving unique views of very small, very large or otherwise inaccessible spaces such as navigating along a DNA helix, probing inside an ant's brain, a human heart, and/or at the other extreme, exploring virtual astronomical spaces like solar systems and galaxies. Other unique roles VRML can play in enhancing education at first may seem trivial. Some educators are beginning to explore its use in the classroom in the form of MOOS or MUDs (Multi User Dimensions) or virtual chatrooms. Finally, the exploration and "mapping" of real terraines and physical places, is a possible use of VRML that in conjunction with "chat" or narrative exchanges, and as an adjunct to shared web-portfolios (especially where QTVR panorama and objects are linked) may really open doors to learning as topics can be put into local community context and differing strategies for dealing with common issues can be shared among reporting students. In describing and sharing each unique community's sense of place or "view-from-here", including student-made local detailed maps, GIS data layers, imagery, QTVR and narratives, students and teachers can create a very dynamic and engaging virtual collaborative.

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Design of a Distance System for Professional ESL Teachers' Support

Peter I. Serdiukov
Department of Educational Studies
School of Education
University of Utah
United States
Serdiu_p@gse.utah.edu

A teacher of English in Ukraine, as well as in any other non-English language country, is constantly facing a number of problems that are associated with his/her professional competency support. Taking into account the complexity of this competency which embraces pedagogical, linguistic, sociolinguistic, and communicative subcompetencies, we realize the enormity of the task of upgrading or, at least, supporting the knowledge and skills that the teacher needs to possess in order to be efficient in the teaching process at school.

In order to develop a system that could provide life-long professional support for the teachers of English as a Second Language (ESL), we need to define these problems. The most urgent among them are:
- Limited opportunities to practice live English and develop communicative competency in the target language in the non-English-speaking country;
- Insufficient inventory of up-to-date, authentic, effective teaching materials and aids for the teachers (textbooks, readers, audio tapes, video tapes, computer courseware);
- Almost total lack of qualified methodological assistance in tackling everyday classroom issues.

To a larger extent these questions concern teachers of remote urban and, especially, rural schools.

Our task was to design and develop a specific support system that could offer all the necessary means for an ESL school teacher to upgrade his/her professional competency without abandoning the teaching process and investing unrealistic time and funds.

Analysis of specific requirements of the ESL teacher regarding support of his/her professional competency reveals that the teacher needs a complex program allowing him/her to systematically upgrade his/her vocabulary and grammar, reading, writing and communication skills; to communicate in English with his supervisor, co-learners, colleagues, native speakers of English; to obtain different learning materials (texts, audio, video and computer courses); to use informational resources like reference books, dictionaries, encyclopedias, journals etc. The teacher also has to have access to a bank of the teaching materials he/she can use in the class activities, to the existing methodologies on how to teach specific subjects and topics, and to the expert who can offer qualified assistance or advice. This system must also meet the following criteria: affordability, accessibility and openness, professional orientation and functionality, continuity, flexibility and self-sufficiency, availability of feedback and of the communication mode.

It is evident that we need to build a non-traditional, powerful informational and learning system based on contemporary pedagogical theories and advanced computer and telecommunication technologies. This system has to be available for any teacher at any school to link to for obtaining the necessary support in any form. Such a system is being currently developed as a Ukrainian national distance system for ESL school teachers' professional competency support .

The system includes the following components:
1. Multilevel subsystem of language training and competency development;
2. A complex of English courses and other learning materials;

3. Reference subsystem with dictionaries, grammar, cultural and other data bases;
4. Methodological support subsystem;
5. Internet facilities for group collaboration and communication.

The system is actually an informational and learning environment that offers the ESL teacher all the materials, means and help he/she needs for successful professional teaching activity in the class. The basic English course that is one of its main components is closely coordinated with the current Program in Foreign Languages for Ukrainian Schools and includes the following topics:

1) Education (system of education, education in Great Britain and USA, high school);
2) Curriculum (school subjects, lesson, English as an tool of international communication);
3) People (I, my family, friends);
4) Life (my work day, studies, free time, vacations);
5) Work (plans for the future, professions);
6) Country and city (basic facts about Great Britain and the USA, London and Washington, DC, Ukraine, Kiev, my home town);
7) World (the planet, geography, environment);
8) Arts;
9) Literature of the English-speaking countries;
10) Sports.

The course is composed in such a way as to offer the user maximum learning materials and activities together with the efficiency and comfort of navigation and use. Modular structure is the main organizational principle of the course according to which it is divided into separate but interconnected modules. Each module is self-sufficient: it comprises all the necessary texts, exercises, tests, additional materials, vocabulary and reference materials, recommendations for the student teacher how to study and for the practicing teacher how to use it in the class. The materials assembled in the module are supplied with such essential characteristics as the topic, summary, level of training, volume (the number of texts and exercises in the module, the number of words in the text, the number of questions in the test, etc.).

Three types of activities are recommended in the system: informational, training and communication. Informational activities are focused on the search, processing and purposeful use of the desired information. Training offers various cognitive activities - individual and group solution of linguistic and pedagogical problems, writing and editing essays and projects, creating and distributing learning materials, submitting entries for the on-line dialogue journal, and working with the computer courses and other materials. Communication activities include exchanging information, writing letters, participating in the on-line dialogues, group discussions, interest group activities and conferences, and peer consultations. Some of the activities are to be done independently, many are to be implemented in collaboration with other members of the group, a few require tutor participation or guidance and supervision. All these activities are aimed at the collective construction of a particular knowledge and development of a common ESL teacher's professional competency in a specific distant informational, learning and social format.

The system for professional competency support of ESL school teachers described in this paper is currently in its development phase. It is supported by the Ministry of Education of Ukraine, the British Council, Institute of Cybernetics of the Ukrainian Academy of Sciences and Kiev State Linguistic University. While working on the project we provide training in Educational Technology for teachers, and conduct research in the course development and methodology of Distance Learning.

Asynchronous Learning Environment for Integrating Technical Communication into Engineering Courses

Patricia A. Carlson
Humanities and Social Sciences
Rose-Hulman Institute of Technology
Terre Haute, Indiana 47803
Patricia.Carlson@Rose-Hulman.edu

Frederick C. Berry
Department of Electrical & Computer Engineering
Rose-Hulman Institute of Technology
Frederick.Berry@Rose-Hulman.edu

This work-in-progress describes a collaborative effort between two faculty members at Rose-Hulman Institute of Technology to build a web-supported integration of technical communication into a sophomore-level course in engineering practices. The collaboration was begun in the summer of 1998. While the integrated delivery environment is still in its formative stages, we believe this presentation is appropriate for ED-MEDIA because it covers two timely issues for engineering education: (1) the efficacy of asynchronous modules for course delivery, and (2) the meaningful integration of technical communication at early levels in the engineering curriculum.

EC 260 -- "Engineering Practice" -- is a two-credit experience designed to prepare Electrical Engineering students both for the senior design sequence and for the world of work. Course goals include:

1. To begin the integration of knowledge through the solution of an industry-sponsored engineering problem.

2. To improve oral and written communication skills.

3. To gain experience in working as a team.

4. To become proficient in using both traditional and information-age resources, enacting a need-to-learn approach.

During the Fall Quarter of 1998, portions of the course were delivered via a web-site, containing assignments, course maintenance materials, resource and supplemental documents, as well as such facilitating features as a chatroom, electronic file transfer, and the potential for online commentary on student-submitted work.

Much of the student's success in this course is highly dependent upon abilities to use sophisticated communication skills. However, at this point in the students' education, most will not have taken a course in Technical Communication (which is offered as a junior-level course at Rose-Hulman). Thus, having access to basic instruction in the oral and written forms of communication required in the course is vitally important.

A series of five web-delivered modules were constructed -- each having interactive/transactional capabilities -- so that students can have on-demand instruction in the verbal aspects of the course. The five modules are listed below. Each highlights a set of "information processing skills" (represented on the left), as instantiated in a specific communication form (represented below on the right).

1. Document Design / Formal Program Report

2. Interpreting and Presenting Data / Feasibility Study

3. Integrating Text and Graphics / Technical Description

4. Audience Analysis and Persuasion / The Proposal

5. Information & Audience Engagement / The Oral Report

While our assessment of the Fall Quarter experience is currently (4/1499) in progress, we believe that the basic premises of the cross-disciplinary collaboration were satisfied and that the web-based learning environment meet the following objectives:

- *Enhanced active learning* -- students had an active role in problem-solving and in discovery learning. Scaffolding and interactive feedback helped students to adjust and consolidate gains in learning.

- *Provided opportunities for collaboration* -- opportunities to share information artifacts and to enhance abilities to work/communicate with peers by providing commentary and accepting constructive criticism.

- *Accommodated transfer of learning* -- course skills and concepts generalized in that the pedagogy encouraged the learner to make connections and extrapolations.

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ATM-Based Distance Education in Germany

Freimut Bodendorf
Department of Information Systems, University of Erlangen-Nuremberg, Germany
bodendorf@wiso.uni-erlangen.de

Introduction

Broadband communication systems and enhanced tools for transmission of video/audio and multimedia data pave the way for new concepts of distance teaching and learning. Especially ATM-based networks allow online teleteaching applications of high quality. In various countries there are strong efforts to establish a broadband communication infrastructure for education and research, e. g. the Internet-2 project in the United States. In Germany the Federal Department of Education, Science, Research and Technology initiated the construction of the so-called B-WIN (Broadband Scientific Network) which started working in 1996 with the secretary of education and research cutting the virtual red ribbon at the CeBit fair in Hannover. Adequate teleteaching environments have been implemented at several universities. Preliminary evaluation results show that students as well as teachers accept the technical add-ons and take profit from the added-values of ' virtual lectures'.

Broadband Scientific Network in Germany

The German Scientific Network is based on ATM technology and connects nearly all of the 70 universities of unified Germany as well as several research institutions (Fig. 1). The ATM backbone operates at 155 to 622 Mbit/s. Universities are hooked up by at least 34 Mbit/s. Actually a Gigabit testbed (2.4 Gbit/s) is being run between Berlin, Nuremberg and Munich. By the year 2000 a nationwide Gigabit communication platform for universities and other institutions concerned with education and research shall be at hand. There are also links to the public ISDN network used as a ramp to that information highway, for instance by high schools. The German Scientific Network is linked to the European ATM backbone called TEN34 (Trans European Network, 34 Mbit/s) as well as to networks in other continents like North America, Asia or Australia.

Experiences

Due to high installation costs for teleteaching lecture theatres and multimedia teacher terminals there are few universities in Germany offering complete 'virtual courses' at the moment. At the University of Erlangen-Nuremberg pilot applications have been run since 1995. Now, teleteaching is in routine operation. First experiences made at the University of Erlangen-Nuremberg are similar to those of projects dealing with distance learning in virtual classrooms. Powerful and stable audio and video tools are crucial to realise an online teleteaching environment which is accepted by teachers and students. After this being achieved first empirical studies have been completed. Different groups of students involved in the teleteaching applications as well as teachers have been observed and questioned.
Here some characteristics:
Remote students: The major advantage they expressed is increased flexibility in place. Especially this means saved travel time which goes together with saved money for public and private transportation. A secondary positive effect for the students is the opportunity to get in touch with innovative computer-based communication and cooperation systems.
Local Students: They don't feel affected by the virtual presence of remote students. Neither positive nor negative influences could be observed. As a side effect digitized lecture recordings, stored on a video server, are highly appreciated for the preparation of exams or simply to refresh knowledge.
Teachers: On the one hand the handling of the technical equipment and the coordination of multiple audiences is demanding, on the other hand a positive aspect is the higher mutual incentive for local and remote participants. The zeal for learning is believed to be better than in conventional lectures.

The on-going evaluation process is accordingly divided into the phases design (definition of goals and objectives), development (analysis of effectiveness and quality), and operation (analysis of costs and benefits). Table 1 shows some selected results coming from an enquiry to characterise the students' basic attitudes towards the teleteaching project. A 1-to-7 scale was used (1 = very bad, 7 = excellent, M = mean, D = standard deviation).

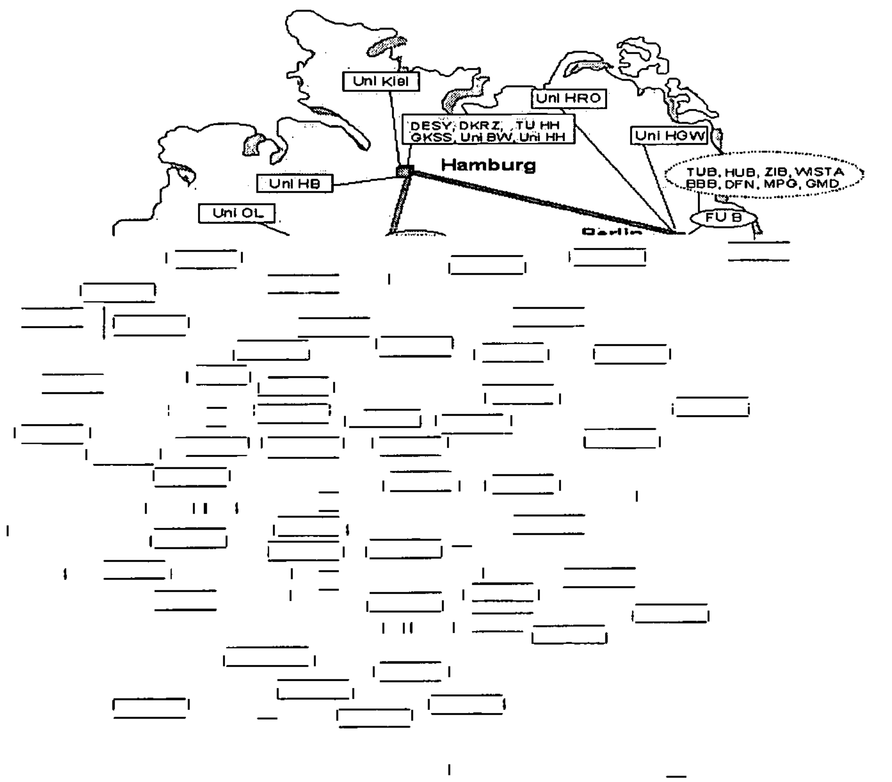

Figure 1: German Scientific Network Architecture

Question #	Aspect	Rating (M)	Dev. (D)
3	overall impression of the teleteaching project	6.21	1.30
5a	improvement of flexibility in place	6.73	0.43
5b	savings of travel / commuting expenses	6.51	0.55
6a	ease of use of the communication and software tools	3.23	1.92
6b	contact with the remote teacher, trainer, or tutor	3.11	1.00
6c	contact with other remote students	3.57	1.51
16	demand for remote access from home	5.00	3.53
19a	learning efficiency compared to conventional courses	4.33	0.47
19b	opportunity and realisation of interaction	4.07	1.04

Table 1: Statistics of Selected Students' Comments

subgroup of children with a home computer, 20.1 % never of rarely used a computer, 15.3 % used the computer about once a month, 37.9 % on a weekly basis, and 26.6 % daily. The older the respondent, the higher the frequency of daily use ($X^2 = 13.9$, $p < .05$).
Chi^2 testing revealed significant differences between gender and computer presence at home ($X^2 = 14.1$, $p < .001$). Of the males, 85.0 % had a home computer, as compared to only 76.9 % of the females. Although more boys owned a home computer in all age groups, the gender gap was only statistically significant for 12-, 16- and 17-year olds. So the assumption that gender disparities are increasing with age could not be confirmed. Overall, girls had significantly less computer experience (29.3 months) than boys (37.1 months) ($F = 23.2$, $p < .001$). When controlled for computer presence at home, this association remained significant ($F = 10.8$, $p < .01$). In addition, males (32.2 %) were found to make more use of a computer on a daily basis than girls (12.0 %) ($X^2 = 78.8$, $p < .001$).
Results indicate that gender disparities depend on the nature of tasks being performed with computers. The use of computers for leisure activities is clearly reported as being a masculine activity. Significantly more boys (73.7 %) reported to use a computer for leisure activities than girls (58.6 %). This gap remained significant when children without a home computer were excluded from the sample: 86.3 % of the boys versus 75.5 % of the girls ($X^2 = 20.2$, $p < .001$). The situation appears to be different when considering computer use for school activities. Similar proportions of girls (58.5 %) and boys (58.1 %) use a computer at home for school activities, but if respondents without home computer were not taken into account, significantly more girls (75.3 %) reported to use computers than boys (67.9 %) ($X^2 = 7.17$, $p < .01$).
The presence of a home computer was significantly lower among children of non-Belgian origin: 73.9 % versus 82.5 % ($X^2 = 8.0$, $p < .01$). The association was only apparent for the oldest among the respondents (17 years or older).
Overall, Belgian respondents reported to have six months longer experience with computers ($F = 6.8$, $p < .01$). However, when the effect of computer ownership was imported as a covariate in the test, no significance was found between the two groups ($F = 1.4$, $p = .23$). Moreover, no differences between groups could be demonstrated for frequency of computer use variable. Respondents of Belgian origin did not report to use the computer more often on a daily basis than non-Belgian respondents. This finding is confirmed for both males and females. Comparing Belgian and non-Belgian respondents, in general Belgian students accounted for a wider use of computers: 8 % more made use of a computer for school activities ($X^2 = 8.8$, $p < .05$) and 12 % more for leisure activities ($X^2 = 12.3$, $p < .01$). The presence of a computer at home seemed responsible for the difference in use for school tasks. In other words, if respondents without a home computer were removed from the sample, no significance was found. This finding could not be confirmed for leisure use: non-Belgian respondents made significantly less computer use for free time activities, even when controlled for computer presence at home ($X^2 = 4.1$, $p < .05$).

Discussion and conclusion

The present findings confirm other studies which clearly have demonstrated gender differences in computing. Besides, this study suggests the existence of cultural differences in computing. Although there are many social and psychological factors responsible for gender and cultural inequalities, the absence of a home computer seems to accentuate the differences between groups.

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Evaluation of IT Course Material in the Context of an Acoustic Design Project

Pieter Vandaele, Dick Botteldooren, INTEC, Ghent University, Belgium
Els Van Zele, Josephina Lenaerts, Center for research in physics education, Ghent University, Belgium
Raoul Meuldermans, KaHo Sint Lieven, Belgium
Marc Van Overmeire, WERK, Vrije Universiteit Brussel, Belgium
Gerrit Vermeir, Laboratory for Building Physics, K.U.Leuven, Belgium

Abstract: To evaluate the use of newly developed IT course material in the domain of acoustics, (http://educinno.rug.ac.be/wetenschapsmuseum), the students had to perform an open design project. The way engineering students at Ghent University tackled the problem and used the available tools to do so, is evaluated through their results and their opinion expressed in a survey. At the same time, their global ideas about the usefulness of information technology in education are explored.

Introduction

To evaluate the learning environments from the project "Distributed Development of a Virtual Science Museum with Guide Applied to education in Acoustics" [1] and test their effectiveness in improving students' insight in complex formulas and concepts, a suitable student project had to be built. A design project seemed the ideal option considering the numerous alternatives and various possible ways to achieve an acceptable result and the different learning paths and styles to be used. The specifications of the project corresponded to what an engineer can expect in real life situations. Students were instructed to design Helmholtz resonator: basic acoustics were known in advance, but the students had to explore more specific information on the Helmholtz resonator themselves. The IT project provided them with learning objects containing illustration of concepts, mathematics, models, model limitation, simulation tools, etc.

To solve the problem the students could follow five different problem solving paths. The path of ...

1. the rote experimenter: look briefly at the general operation principle and use the virtual experiment to accidentally come up with a reasonably good solution.
2. more intelligent trial and error: derive a mathematical relation between a few design parameters from the general operation principle and investigate only valuable combinations experimentally.
3. a meaningful experimenter: start with some trial and error, realize there must be a reason why some parameters do not seem to have any influence, turn to the theory to find out if there is a theoretical background for this and eventually return to experiments to determine the last degree of freedom.
4. a theorist (pure mathematics): combine the available mathematics to come to a result possibly using some numerical solvers.
5. an expert: use the formula to relate some parameters, investigate more detailed theory to find some physical and technical restrictions, solve the last degree of freedom using mathematics and their own software or the applet, finally turning to the derivation to find out if their design is well within the limits of applicability of the theory.

Survey and exam results

The students reported their ideas about the importance of the several factors for solving the problem: the virtual experiment, derivation of equations, limits of the theory, other Internet pages, communication with peers, literature, and their perception of the insight they gained in some acoustic concepts. Despite a small statistical population of 27 students, some interesting conclusions can be drawn:

- Part of the goal of the design project was to urge students to learn the theoretical background by exploration of additional resources. About 66% of the students state that they gained insight into the theoretical background. We consider this a reasonable success.

- Students focussing on experiments affirmed they gained insight in the problem at hand but they did not learn about the theoretical background. They probably followed paths 1 or 2 mentioned above.
- The more students perceive the equations and underlying derivations as important (solution paths 3, 4 and 5), the more they get the impression they understand related theoretical topics. However the correlation with their impression of understanding how a Helmholtz resonator really works gets lower and even becomes negative, although this tendency is not reflected in the students' exam result of questions related to the topic. Perhaps students only realize the complexity of the matter when they study the topic thoroughly.
- There is a negative correlation between the student's global result and his perception of insight gained. This can mean several things: the material is not good enough and better students are left somewhat unsatisfied, or better students do not easily state understand something completely, or the students who perform well in the current educational system are not inclined to put much effort in an alternative project. One thing is sure: it is a question of perception since there is no negative correlation with their examination score on the question related to the subject.

This project forced students into using IT. After this (for some students 'first') IT-experience for educational purposes some general questions about the appreciation of IT were asked. The following trends reflect their ideas:

- there is a strong negative correlation between the wish to get more interactive multimedia material (as was presented to them) and the student's performance in the current system.
- the students almost unanimously approve the usefulness of self-assessment tools to evaluate the level of understanding they have reached.
- applets allowing students to explore the influence of parameters in a mathematical theory are highly appreciated, as are additional self-assessment tools.
- the possibilities of hypertext to hide unessential information or to cross-link different topics is not estimated very high by the average Flemish engineering student.

Conclusions

In general students appreciate the collaboration and the exploration type of approach of a design problem on a subject they had no prior knowledge of. The exploration stopped at an earlier stage than hoped for. This could be due to the way the problem and the tools were presented, but "the study culture" of Flemish engineering students probably explains a lot. It is not a habit of these students to consult literature, search the web, etc. When using IT in education one has to be considering the study culture of the students, which is hard to change.

There was an unexpected negative correlation between the general performance of students in the traditional educational model and their appreciation of the project and IT in education in general. Since one of the initial goals of this project was to make sure "better" students had the opportunity to learn more than in the traditional educational approach, some tuning seems appropriate, in order not to loose those students.

As we expected, there is some fear of loosing track and of doing things that are not really essential in order to be able to pass the exam. In the first semester of 1999-2000 we try to respond to this by structuring the software agent we called "the guide" in such a way that a clear path through the material is outlined and that the structure becomes more evident. Hyperlinks are applied in a more structured way by the use of icons indicating which type of hyperlink can be expected: example, practical application, additional explanation, more background, etc.

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Malaysian Smart School – Vision Vs. Reality

Vijaya Kumaran K.K.Nair
Multimedia University
Cyberjaya, 63000 Selangor, Malaysia
vj@hypermedia.com.my

Abstract: The Smart School Project is one of the flagships of the Multimedia Super Corridor. The Malaysian government has established partnerships with the private sector through the Concept Request for Proposals (CRFP) process. This paper will critically analyze the concept of Smart School in the Malaysian environment and look into the issues relating to implementation of this concept as per the vision of the Ministry of Education Malaysia. The paper will go further to provide empirical proof with regards to the mind set and the response to the Teaching-Learning component of the Smart School Concept, from the view point of in service teachers.

Introduction

In July 1997 the Prime Minister launched the Flagship Application documents to invite proposals for solutions from the private sector within and from outside the country. The Education Ministry based on critical and creative teaching-learning approach planned the Smart School concept. Technology as an enabler became an important component of this flagship. The exercise is to help the Malaysian student community to cope with the Information Age.

The main components in the Malaysian Smart School are:

1. Teaching - Learning Process - here self-accessed and self-directed learning will be encouraged
2. Management and Administration - the school Management and Administration will be technology driven for efficient and effective management of resources and to support the teaching-learning process in 1 above.
3. Human Resources, Skills and Responsibilities - active role play by Parents, Community and the private sector as Stakeholders
4. Processes - review of input and output
5. Technology - to be used as an enabler i.e. as a means to the end and not as an end to the problem
6. Policies - changes in existing policies and regulations over and above new policies and regulations

Objectives

The objectives of the Smart School Project are:

1. To produce a thinking and technology - literate workforce
2. To democratize education
3. To increase participation of stakeholders
4. To provide all-round development of the individual
5. To provide opportunities to enhance individual strengths and abilities

Implementation

The Ministry of Education has planned for a three-year Smart School Pilot Project through the CRFP process. Ninety (90) pilot schools have been picked for the pilot stage which will involve three levels of technology, i.e. level A, B+, and B.

Level	Total Number of Computers	Description
A	Primary – 406 Secondary – 479	Schools in this level will be equipped with state –of-the-art technology. Each school will have two computer labs and each classroom and science lab will be equipped with computers.
B+	86	This level is based on classroom model. This model is based on group-based activities and project work. Computers are available whenever needed for information access, writing reports, developing presentations, e-mailing etc.
B	42	The majority of schools will implement technology supported learning by use of a computer lab. Students will use the facility to access information, use software application for various purposes and work on available courseware in the four subjects.

The Government intends to play a role as an architect and driver for the Smart School Project. The Ministry of Education will prepare guidelines and provide the basic amenities to schools according to their individual needs. The Ministry is also actively encouraging schools to become Smart Schools on their own initiative by using their own financial resources and expertise. The Pilot Project period is three (3) years from 28th July 1999 to 22nd July 2002. It is projected that all schools in Malaysia will be Smart Schools by the year 2010.

Reality

The Malaysian government is spending over RM. 300 million for only 90 schools to be wired, of which RM. 183,573,737 for Capital Expenditure and RM. 116,426,263 for Operating Expenditure. As per the time line set, from 13th March – 22nd March 2000, the installation of Release 1 software (Teaching-Learning Materials and the Smart School management System) is to take place.

However on 20th February 2000, The Star (National Daily) reported the Director – General of Education saying that the "smart school" project in 90 schools nationwide will be further delayed because of hitches in the software development for the lessons. He had said that the "slight delay" was due to the fact that it took time to develop the courseware. The pilot project was suppose to take off on Jan 1st 1999, but was delayed for several reasons including lack of funds and courseware. The infrastructure for the implementation is ready in `80 of the 90 schools for the full implementation. The Education Deputy Director General stated that the software for the 4 subjects took time to write, and to evaluate them. He went on to say that it will take about 4 years to fully develop and implement the program.

Among the reasons for the delay were:

- lack of fully developed smart school curriculum
- lessons being rejected several times
- difficulty in contacting evaluators(Ministry of Education)
- lack of communications
- rejection after many rounds of evaluation
- evaluators not exposed to technological limitations

Should the consortium entrusted with the development of the courseware implement software engineering principles in developing the courseware? If the basic software engineering principles had been incorporated, couldn't most of the above reasons for rejection be done away with?

Evaluation throughout the Life Cycle of a Multimedia Tutoring System

Maria Virvou, Victoria Tsiriga
Department of Informatics,
University of Piraeus,
Piraeus 18534, Greece
E-mail: {mvirvou | vtsir}@unipi.gr

Introduction

One of the primary aims of educational software is to be used in real school classrooms. However, a lot of educational software has been criticised that has not been designed to meet the needs of real schools settings. The above criticisms show that there is a need to introduce research results of educational technology into the environment of real classrooms. A solution to this problem may be the involvement of school teachers in the development of an ITS (Virvou & Tsiriga 1999a) and the application of evaluation methods on every stage of the tutoring system's life cycle. In this way we can ensure usability and learning effects.

For the purpose of this research, a multimedia tutoring system was developed. The system is called EasyMath and incorporates intelligence. EasyMath's model of life cycle has been based on Object Unified Process (Kruchten 1999), an object oriented process that suggests multiple iterations of the software development phases. In this way, we have ensured multiple iterations of evaluation of the design and executable releases of EasyMath.

Evaluation of the Design

Evaluation of the design of EasyMath was considered very important in order to ensure that the expertise incorporated in the error diagnosis component would be acceptable by the majority of school teachers. EasyMath's error diagnosis and student modelling have been based on reconstructive approaches which have been used in many ITSs such as (Brown & Burton 1978). These systems reconstruct the problem solving process and generate mal-rules from hypothesized faulty solution paths which are used for the modelling of students' misconceptions or procedural bugs.

At this stage we aimed at evaluating the error diagnosis component in terms of its cognitive principles and completeness. Therefore, ten school teachers were given a computer based questionnaire with questions that had been answered erroneously. The faulty answers were produced using the library of the most common misconceptions that were encoded in EasyMath. The questions covered the whole range of exercises included in EasyMath. The questionnaire consisted of ten questions. In each one of the questions, each teacher had to provide a justification of what s/he thought the underlying misconception was. One problem in this stage of the evaluation process was that many teachers did not provide any explanation and just gave the correct answer to the question.

Evaluation of a Primary Executable Release

In an early stage of the development, a prototype of the tutor was ready to be used by its end users. This prototype was used in order to perform a primary evaluation of the system. In the phase of the primary release evaluation, two school teachers along with ten students were involved. The evaluation methods employed comprised qualitative techniques, such as direct observation and questionnaires.

The main focus of this phase was on the evaluation of the user interface and the several types of the exercises provided by the system. Teachers and students were asked to comment on the working environment of EasyMath. Furthermore, they had to express their opinion about whether the amount of different exercises encoded as well as the form of these exercises were adequate.

The teachers and the students involved in this phase were introduced to EasyMath and were then asked to use it for about an hour. During their interaction with the system, an evaluator was present, trying to note down the difficulties that the users had encountered while performing predefined tasks. After the interaction with EasyMath, both the teacher and the students were given a questionnaire to answer. The questionnaire was designed taking into account a set of "usability heuristics" presented in (Nielsen 1994). The questionnaire included questions such as:

1. Were instructions for use of the system visible or easily retrievable whenever appropriate?
2. Were the symbols and the words used in the different components of EasyMath consistent?

The first question corresponds to the need for recognition rather than recall, while the second question is related to the need for consistency and standards. The comments made during this stage of EasyMath's development were used as the basis for the refinement of the requirements of the system and the construction of the final product.

Formative Evaluation Using a Set of "Learning with Software" Heuristics

The involvement of school teachers in the phase of the evaluation of an ITS was considered crucial. In addition, it is also important to track students' use of resource based packages very closely to uncover the problems and successes. For the above reasons, in the phase of the formative evaluation of EasyMath, 10 school teachers as well as 240 students were involved. Both students and teachers were asked to evaluate EasyMath in terms of the purpose of education. In addition, teachers were asked to evaluate the overall performance of the system and express their opinion about the usability of such an ITS in a real classroom.

In the stage of the students' evaluation of EasyMath, the students were separated in two portions. The first 120 students were introduced to EasyMath and were asked to use it for an hour. Then, they were given a questionnaire to complete. For a more detailed description of the results of the questionnaire, the reader is referred to (Virvou & Tsiriga 1999b). As for the rest 120 students, they were taught half of the syllabus in algebraic powers without the use of EasyMath and they were given a written test. Then they used EasyMath while being taught the rest of the syllabus. In the end they were given another written test and the grades of their first and second test were compared. The results showed that 46% of the students obtained a better grade in the second test, 43% obtained the same grade and only 11% obtained a lower grade in the second test.

The evaluation questionnaires used in this phase were constructed based on a set of "learning with software" heuristics, introduced by (Squires & Preece 1999). These heuristics are an adaptation of "usability heuristics" (Nielsen 1994), so as to relate to socio-constructivist criteria for learning. "Learning with software" heuristics have been suggested by their inventors as a method for performing predictive evaluation. However, we have used them to construct a formative evaluation questionnaire, that would give us insight about the integration of both usability and learning issues.

In the phase of the overall evaluation of EasyMath, the teachers who participated in the evaluation were asked to role play an average student interacting with EasyMath. Next, they were given a questionnaire to fill in. The questionnaire was carefully designed so as to ensure that questions are related to as many of the "learning with software" heuristics as possible.

Conclusions

To produce efficient educational software, there is a need to ensure the correctness of the domain knowledge as well as to evaluate the usability of the product. One way to achieve the above goals may be the application of evaluation methods on every stage of the tutoring system's life cycle. In addition, evaluation should involve both human teachers and students in order to maximise usability in real classroom settings.

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Neuromance, Or Is The Old Flame Still Best?

Simon Walker
School of Post Compulsory Education and Training
The University of Greenwich
UK
S.H.Walker@gre.ac.uk

Abstract. This work in progress paper reports on whether hybrid CD-ROM technology used to train or supplement the training of mentors of beginning teachers in Vocational Education and Training is an improvement upon traditional face to face and print-based delivery. It argues that the shifting ground in pedagogical models can confuse educational software developers but an understanding of a theoretically driven level of explanation of learning may assist decisions about learning approaches and choice of technology.

Introduction.

Faced with a climate of change, educational institutions are under increasing pressure to explore new ways of learning. Emerging trends in Information and Communication Technologies (ICTs), combined with national governments initiatives to use ICT and widen participation in lifelong learning (in the case of the UK, the influential Dearing, Higginson and Kennedy reports), have created a framework for supporting an increasing community of participants in education and training.

The development and introduction of ICTs into the further and higher education and training sectors has stirred debate about pedagogical performance versus educational efficiency. In training, the debate has focused on issues of *Return on Investment* (Hawkins, et al 1997). Factors of cost and value for money versus amount of learning and quality of learning characterise educational and training evaluations A lack of separation of these factors has created a cloud of confusion, and decisions about allocations of scarce resources are not always made in a manner that maximises the collective benefit of the community.

Many would contend that ICTs are not only cost efficient (Boulet & Sene,1997; Greenwood & Recker, 1996) but they also promote more effective learning (Resnick, 1987; Fjuk & Dirckinck-Holmfield 1999). Others call for more caution to be exercised about such claims. In the UK, the push towards the integration of computer-based education within education and training has been made at the highest levels with funding to match. The premise is that ICT can deliver more effective learning than traditional media.

There is no one single recognised right way of thinking about learning; theories constantly change and tend to reflect the attitudes and technologies of their time. The literature points to shifting ground in pedagogical models.(Reiguluth 1999; Herrington & Standen, 1999). Currently the debate is influenced by ICT.

It is of some concern therefore, that educational software developers have an understanding of a theoretically-driven level of explanation that identifies the kinds of cognitive activities (such as learning, memory tasks and problem-solving) that could take place through the physical activities provided by an interface. To produce successful tools for learning, it is necessary to understand the nature of the learning process and the impact of context within which learning operates.

Background

There is a particular need at the University of Greenwich each year to train up to 250 new and existing workplace mentors who support trainee teachers on the Post Graduate Certificate of Education (PGCE) in Post 16 Vocational Education and Training (VET) during their teaching practice.

The learning demands and needs of these mentors are relatively different to the more conventional learner and it may be argued that the instructional approach is different. Firstly, it concerns the training of trainers. Secondly, there is no set curriculum to follow, or assessments to be made; thirdly, there are no prerequisites other than being a teacher/trainer within the selected institution and lastly, whilst the institution is paid for the efforts of their staff, the mentors personally go largely unrewarded either by time, cash or qualification inducements.

Although some mentors may work within the same organisation, many others do not and generally they work largely independently of one another. Institutions span a large geographical area across London and the South East of England and mentors rarely meet with one another to discuss their role.

There is no substantial proof to suggest that a trained mentor is more effective than an untrained one (Jowett 1998), however, training does enhance an understanding of the stages of a relationship, the mentoring process and it enables critical reflection on professional practice. Conventional mentor training, by virtue of location, time and resources, can only address a small number of aspects of the mentoring process - the tip of the iceberg. Malderez and Bodoczky (1998), take the image of the iceberg further and draw a parallel between the tip, which is out in the air and represents the visible 'good professional' and the main body of the iceberg, which lays unseen and represents all that the professional engages in as an expert in their subject and as a mentor. The submerged part represents the mentor's thinking, planning, and engagement in process, and draws upon their knowledge, understanding, values, feelings and attitudes. The mentor's ability to respond to the student teacher's professional development hinges on their understanding of the role and on their own development as mentors. An analysis of these elements forms the content of the interactive tool.

Project Objectives and Scope.

In its current form, training is administered through a combination of print-based distance material and a single workshop session for *some* mentors at the beginning of the academic year. Our initial research showed that the majority of mentors would be willing to use IT for training purposes, although we identified a number of constraints; some were institutional such as the limitations of the technical specification of equipment provided by colleges (processor speed, CD-ROM drives, soundcards, the ability to play video, etc) and some personal constraints such as knowledge about ICT and confidence in using the computer. The pursuit of a technological solution to provide support and training, independent of time and location was compelling.

In 1998 the *Mentor in cyberspace* project undertook to produce an alternative means of supplementing the existing mentor training and support. Interactive multimedia, it appeared to us, offered the best chance of developing a range of tools and resources to support mentor processes such as thinking, creativity, self-reflection, problem solving and the development of professional attitudes & approaches over time. At the start of the project only a small number of academic institutions which were not universities had organised individual internet access for their staff. We considered the lead-in time for the project to be sufficiently long to utilise the hybrid function of CD-ROM technology with its ability to connect on-line. Furthermore, the University's on-line Campus (OLC) was under construction and the idea of extending the range and type of tools available to mentors was attractive.

Learning approaches.

Selecting instructional methods on the basis of the theories has not easy because little agreement exists between the main protagonists. The constructivists attack instructivist design approaches as formulaic and mechanistic. Defenders of instructivist design have attempted to re-establish its authority at the expense of all other approaches. They take a staunch position against the infringements of, in Merill's words, "these persons who claim that knowledge is founded on collaboration rather than empirical science, or who claim that all truth is relative" (Merill, cited in Wild and Quinn 1998, p 74). In much of the current and recurring debate about the role of learning theory in educational interactive multimedia there appears to be a readiness to assert one theory of learning over another - to present one as being deficient and the other as the only credible explanation of learning.

The important issue is to match the instructional approach to learning need whatever the level, whether this is the efficient dissemination and testing of knowledge, the creation of new personal knowledge or the development of opportunities for networking and collaboration. In a professional context where the goal is to encourage the acquisition of reproductive *and* productive skills and knowledge, a balance must be struck between those methods that appear to work best.

Our approach has been to try to strike a balance between these two ostensibly opposing theories and adapt the technology to suit the perceived learning needs of the mentors. On analysis of the strengths of each learning approach in relation to our purposes, we saw that instead of contradicting and negating each other, these two approaches could be complementary. We perceived that the use of hybrid CD-ROM would combine both learning approaches. CD-ROM is a relatively closed technology, limited by its content and design. Our design here draws upon the strengths of Instructional Systems Design (ISD): its emphasis on presentation, information, structure and reinforcement is useful for the reproduction of knowledge (Boyle 1998) and is suited to interactive multimedia on CD-ROM. Web technology, on the other hand, is characterised by an open, explorative architecture. Accordingly we have used web technology, specifically Computer Mediated Communications (CMC) which supports a more constructivist approach: it is able to provide a set of tools and methods for the mentor to construct new knowledge within ill-structured, authentic, real contexts (Brown,J.S., Collins, A., & Duguid 1989). Hybrid CD-ROM offers the possibility of combining the reproduction of knowledge with the production of 'knowledgeability' (Guile & Young 1998).

This work in progress will report the findings of a pilot study ending in June 2000 with approximately 20 mentors who will have utilised the various tools and approaches during this academic year. The particular focus of the research will examine whether:

- mentors preferred to use the hybrid CD-ROM or the print based material for learning about their role
- one instructional approach or technology was more successful than the other.

I will attempt to draw conclusions about the success of introducing interactive multimedia and whether the use of ICT in this context is an advantage for training and supporting mentors of beginning teachers in VET

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Visual Lab - A Multimedia Virtual Experiment Environment on WWW

Chao-Chiu Wang
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
mfc42@ms24.hinet.net

Maiga Chang
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
maiga@ms2.hinet.net

Chang-Kai Hsu
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
ken@mcsl.ice.cycu.edu.tw

Jia-Sheng Heh
Department of Information and Computer Engineering
Chung Yuan Christian University, Chung Li, 32032 Taiwan
jsheh@ice.cycu.edu.tw

Abstract: This paper proposes an open architecture of Visual Lab on WWW and focuses on scientific experiment for the asynchronous mode of distance learning. Visual Lab is a virtual experiment environment by using video-media. A complete scientific experiment in Visual Lab includes four essential stages: phenomenon observation, experiment process observation, data measurement and experiment recording. In Visual Lab, students can carry out experiments remotely with the toolbox designed on Internet. A system architecture built on World-Wide Web demonstrates the feasibility and flexibility of our idea.
Keywords: Distance Learning, visual lab, scientific experiment, World Wide Web.

1. Analysis of Scientific Experiment in Visual Lab

For a full scientific experiment, there are several essential stages: *phenomenon observation, experiment process observation, data measurement* and *experiment recording.* These essential stages are analyzed details in the following.

Phenomenon Observation: With such knowledge, phenomenon observation can be divided into two categories

(a) **Static Observation.**
(b) **Dynamic Observation.**

Experiment Process Observation: It is very important to practice with one's own hands. After experimenting themselves, students can gain much impression.

(a) **Traditional Process Observation.**
(b) **Video Observation.**

Data Measurement: Data measurement is the key to prove a physics theory.

(a) **Equipment Usage in a Traditional Lab.**
(b) **Usage of Simulation Tools.**

Experiment Recording: The formats of experiment records have to be designed.

Problems Analysis of Four Essential Conditions on WWW: The formats of experiment records have to be designed.

(a) **Video Format:**

	Compress	Network Transfer
MPEG	No	No
Real Video	No	Yes

AVI	Optional	No

Table 1: Video formats comparison.

(b) **Component Format:**

	Download	Security	Control Operation	Browser Support
Java Applet	Light	No	Can not access local files	Both IE and Netscape
Real Video	Heavy	No	Can not control	Both IE and Netscape
Window Object embedded in Web page	No	No	Can not control	IE
ActiveX	Heavy	Yes	Full control	IE
Application	Heavy	No	Full control	Both IE and Netscape

Table 2: Comparisons table of web technologies.

(c) **Experiment Record:** Students can record data what they want to measure and send out these data to teacher. Then teachers can gather all the student learning information via the function provided by experiment record.

2. Design the Platform of Visual Lab

In this section, several toolboxes will be discussed. Each measurement and observe components must applied these toolboxes in Visual Lab platform.

Measuring and Observing Tools: For a Visual Lab System, measuring and observing tools are helpful to both students and teachers

(a) **Video Controller:** To play some experiments video.
(b) **Scale:** In order to measure the actual length from the experiment video.
(c) **Ruler:** Students can adjust the length of this ruler tool to can get the length what they adjust when they saw in the video.
(d) **Protractor:** Students can measure the angular magnitude.
(e) **Calculator:** Students can input the data and get the result just like a calculator.
(f) **Timer:** A timer is needed to measure time in scientific experiment.

Components of Visual Lab: Each learning work is implemented by an independent component, and our architecture can be illustrated as (Fig. 1) shown.

3. Implement the Visual Lab on WWW

We designed a platform using open architecture technology. Our purpose is that all of the physics experiments can apply in Visual Lab without any modification. As long as teachers film the experiment and join in Visual Lab, students can experiment in Visual Lab environment and record with Microsoft Excel 2000, as show in (Fig. 2).

4. Conclusion

This paper proposes an open and reusable architecture of Visual Lab on WWW. All of the scientific experiments can apply to Visual Lab based on the architecture of Visual Lab had been accomplished. Learners can learn knowledge by experiment in the Visual Lab even they are not at school. Solution for transferring video stream through network should be the next research direction to enhance Visual Lab.

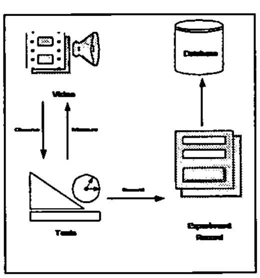

Figure 1: The architecture of Visual Lab.

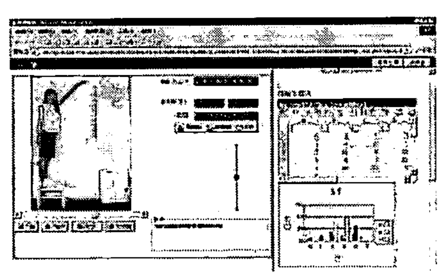

Figure 2: Scientific experiment

Professional Development Institute vs. On-line Course: Comparing Two Online Collaborations for Designing Technology Integrated Instruction

Elizabeth Wellman, Ed.D.
Graduate School of Education and Information Studies, Center X, UCLA, USA
ewellman@ucla.edu

Maya Creedman
Graduate School of Education and Information Studies, Center X, UCLA, USA
creedman@ucla.edu

Jana Flores
California History - Social Science Project, UCLA, USA
jsflores@ucla.edu

Abstract. Two groups of teachers, 50 K-12 History teachers from California and 20 K-12 teachers in a Masters program in Massachusetts, participated in an online experience to develop instructional materials which integrate technology into the curriculum. Each groups' level of participation in online communication activities and the method that their instructional design process was developed predicted the quality of the final materials. Recommendations for structuring online collaborative activities for teachers to develop instructional materials are given.

Introduction

This is a comparison of two on-line collaboratives with the same purpose -- to have teachers develop K-12 technology-integrated instructional materials -- but significantly different approaches. The two projects we are using for this comparison are a California statewide professional development project in K-12 History (CH-SSP) and an on-line course in Project Based Learning for a Masters degree program in Educational Technology at Framingham State College in Framingham, Massachusetts.

Key Factor - Participation in Communication Activities

For all participants, developing instructional materials was a process that involved participant to participant, and participant to facilitator/instructor communication using an online space and several forms of electronic communication. There were six different forms -- online chat, face-to-face, online submission of original written material, online response to others written material, participation in the online discussion forums and e-mail. The greater the participation in online activities, the more probable that the lesson plan was completed and the more likely that those lesson plans were of high quality. There were significant differences between the groups in their participation in on-line activities. The professional development group participated significantly less than the online course group. There were two primary reasons for this. Although both groups were required to participate, there was no tangible consequence for not participating for the professional development group. Second, technical resources and technical help were more readily available for the online course participants than the professional development participants.

The greatest disparity between the groups was in the discussion area. The postings for the professional development group were sparse to non-existent. No discussion ever emerged. For the online course, this was unquestionably the most successful communication. The discussions were interesting, in-depth, meaningful and at the Masters level. The major difference between these groups is that the discussion was participant driven for the professional development group and instructor driven for the online course group. We find this to be problematic, as one of the goals of the professional development is to have the participants drive the interaction.

Key Factor - Instructional Design Process

An important component of the CH-SSP project was the development of the instructional design process. CHSSP was interested in having the different grade level groups develop their own process for the development of the lesson plans. In the Project Based Learning course, conversely, the instructor strictly imposed the process and the students were, in part, evaluated on how they used this imposed process. We refer to this difference as a self-generated process (CHSSP) vs. an imposed process (Framingham).

The different process experience led to significant differences in the final product. The self-generated process group spent a great deal of time developing the process. As this was a new experience for them, there was confusion regarding what was being asked of them. This detracted from the application of those processes to the instructional materials development. We still feel strongly that we would like to see the process of materials development arise from the teachers that are using the materials. We feel changes need to be made to focus more on the development of the materials themselves.

Recommendations

We have several recommendations. There were many difficulties with the professional development institute, most of them centered around participants actively engaging in the online communications, and participants understanding facilitator expectations in relationship to the process of instructional materials development. We would prefer, encourage and work towards that process being developed by the participants themselves. However, many of the participants, from both groups, felt the need for more structure and more direction in how to go about developing the materials. We do not know if this was because they were using a new environment and felt unsure about how to proceed, or if they would have difficulty developing instructional materials without an imposed process in any environment. In the future, In the professional development project, some direction needs to be provided for the development process, however, this process should remain fluid for the participants. In the online course, we would recommend that a portion of the beginning of the course be spent with the participants examining their own practices of instructional materials development.

The professional development institute needs to provide a more concrete reason for the participants to actively participate in the online environment. Providing participants with a 'reward' at the end, such as a stipend, University Extension credit towards salary points, or the like may be an important component to motivate participants. Technical support is also essential. It may be best that technical support be pledged from the district as that is frequently the ISP for the teacher. It also provides a district commitment to the project.

In general, online instructional materials development, in a group, collaborative setting, needs a structure to support it which includes facilitator support for the multiple forms of online communication, technical support, and clear guidelines for the participants process. In addition, participants need a tangible motivation for completing the project, such as salary points or a stipend. These online development projects differ from traditional development projects in that they can be conducted asynchronously and between participants who are at a geographic distance. For the future, we hope that the communities that are formed can continue on, develop further materials and expand to provide online support for other teachers in their subject areas or grade levels.

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Using a Wrench to Pound in a Screw:
The Misapplication of Communication Technologies in Education

Eric Wignall
Instructional Design & Educational Media Labs
Purdue University Calumet
United States
Wignall@calumet.purdue.edu

Abstract: This short paper illustrates a framework for examining the application, and misapplication, of media types and contexts in educational settings. It illustrates a relationship between form, format and function that is useful in determining the effectiveness of new media technologies in educational contexts.

Your home has a drawer or box in some convenient place where you can always reach the most useful tools; a flashlight, a ruler, a roll of tape. But there have been occasions where rummaging around in that drawer didn't get you the desired tools. You want to hang a picture on the wall but you can't find a nail, only some screws. You realize that a screw would work for hanging the picture, only to find you don't have a screwdriver. You rationalize that the picture isn't all that heavy so you could just pound the screw into the wall and take care of it, but there isn't a hammer to be found either, only a wrench. This tool, clearly not designed for the task, is pressed into service and with a little effort, hopefully without broken fingers, you indeed hang the picture. You may not have used the right tool for the job but the job was done. Because the picture now hangs over and covers the screw you are also able to hide this odd choice of a mounting device from visitors who would admire the picture.

This short paper is meant as a starting point for examining educational effectiveness of technology applications by matching format, function, and context. In far too many cases today the wrong tools are being used in the wrong context, supporting the educational process in ways that are left unexamined by educational researchers and instructional designers. We are getting the job done with whatever we have available and no one is looking at the inventory of tools in the drawer. The efficiency and effectiveness of technology in educational settings cannot be measured solely through the final output of an educational process. The latest studies of the use of computers for educational purposes, now focusing on the role of the Internet, have provided a confusing mix of contradictory results. Most of the studies are hopeful in tone but unclear about the benefits, or even the overall value, of using the Internet as a medium of education. It can be used, so it is being used.

Educators have a long history of adopting and adapting to new communication technologies as they enter society-- sometimes with great effect. Other communication technologies have been misused in specific applications by teachers and learners and abandoned for all other uses. The awareness that a communication tool can be used in an educational setting is related to the need that could potentially be satisfied by the new technology. If the tool does not not immediately satisfy the need, it runs the risk of being abandoned. If the tool can satisfy an educational need even through a use that was unintended, even inefficiently, it will be adapted to suit the purpose. The effectiveness of this use can be improved through an understanding of the educational process, its context, and the effects of communication tools on teaching and learning.

Communication formats and settings

Linking communication environments with educational settings is a valuable starting point for comparing the operational effectiveness of a new technology tool in context. the following six educational/communication environments are based on mass communication theories that grew from research efforts through the 1940s and 50s .

Figure 1. Formats & Settings

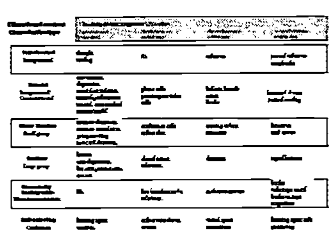

Figure 1. If the effectiveness of educational technology is to be measured it must take place, necessarily, at one of these levels, and perhaps be used as a tool at several levels. The understanding that different types of communication contexts offer differing levels of interaction with educational material, and thus provide a variable basis for learning, is essential for measuring the effectiveness of the application of technology tools at each level of interaction.

Figure 2.

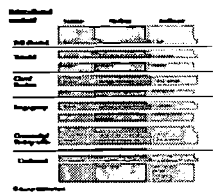

Figure 2. The quality of educational interaction breaks down when at lower levels of activity, and cannot be applied at all at higher levels of interactivity. Interpersonal communication cannot take place over mass broadcast technology, but lectures can be misapplied to interpersonal tutorials. Media technology is most effective for education when context and type match interactivity.

Media types and technology tools

The historical development of multimedia, the combination of moving images, sound, and graphic information, begins with the development of motion pictures and extends to today's subscription television cable systems. The impact of these multisensory media on viewers in the immersive environment of a darkened theater or near the electronic hearth of individual homes is complex and impressive. Multimedia technology has become more sophisticated and multilayered, allowing for multiple languages, commentary, text, and audio input and feedback. This is all the more remarkable in view of the almost total lack of feedback in early silent movie production, mass broadcast television monopolies, and linear videotape media.

Coalescent media is the result of both technology and media convergence. It represents the development of a new, digital, component-based medium. Coalescent media have emerged from the development of computational and data management tools, publishing software, digital audio and media, hypertext, and hypermedia. The linkage of different components occurs in contexts provided by the user in ways determined through navigational choices made on the spot by the user. Today web pages can be built by relational databases on demand. Users select options and the database engine places the requested information in an HTML document using preselected parameters. The limitations of current database technology combine with bandwidth restrictions to limit the potential of this early technology to combine and recombine data, in numerous forms, based on searches of worldwide resources. Coalescent media will be first relational, drawn together through user demand and user selected interaction parameters. Later developments may find hypertextual hypermedia coalescing into forms of communication that extends the capabilities of text, audio, or info-graphics by extending the interactions users have with new combinations of that media. This hyperlinking of other media types, in constantly shifting referential and contextual frames, is creating a new type of medium that demonstrates the characteristics of each level of interaction and uses each previous type of medium. As technology escapes the limitations of keyboards and screens we will see new types of interactions take place in contexts wholly created and invented by the user, not producer, of the content. New technologies being developed are allowing different types of interactions with content in contexts not imagined by the author. We are only beginning to see the curve rise in the growth of computational efficiency and the rise of new computational technologies.

Educational institutions are currently setting learning requirements, and designing the curricula to reach them, through interactions with government, professional and industry interests. These may be anything from international professional societies to locally elected school boards. What will education look like with information age learning requirements and learner-defined knowledge building? If the individualization of economic activity continues, what role will educational institutions play in defining or providing education? Does the personalization of education erode or enhance the role of educational institutions?

Conclusion

Driven by a need for improved commercial skills and abilities learners are rejecting the constraints of semesters and grades for the realities of deadlines and competencies. The growth of asynchronous distant learning systems has been dramatic, reflecting both the new availability of learning through new technologies, and the growing demand for training and education. Knowledge workers need to respond to demands for new, more valuable, knowledge on an accelerating time scale. Traditional educational institutions entering the distance education marketplace are now faced with a similar dilemma; the multifaceted role of information provider, curricular coordinator, skill assessor, and content producer. Institutions are now faced with competition not from other institutions or organizations, but from individuals operating outside of traditional knowledge production frameworks. Without the capital investment needed to create a scriptorium, library, or research lab entrepreneurs can respond to the demands of a new economy in ways that slow moving institutions cannot. Research into the improvement of learning using new media technologies, in different contexts, is not just important. It is vital to the improvement of educational systems that take advantage of each medium.

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Formative Evaluation of Learner-Centered Web Course Design: A Strategic Analysis

C. James Wong
Instructional Technology & Distance Learning, Learning Resources Division
Southwestern Illinois College
cjwong@mail.southwestern.cc.il.us

Introduction

A poorly planned and developed distance education program will lead to negative learning outcome. For example, when a Texas college began to offer on-line courses taught by instructors without the skills and experience to teach on the Internet, only about 40% of students who enrolled in the on-line courses completed them (Simpson, McCann, & Head, 1999). From the same logic, a poorly designed Web course interface will have a negative impact on the entire distance education program.

This paper discusses the roles of instructional design and interface design in the development process of a Web course. Although the principles of both instructional design and interface design emphasize the importance of formative evaluation, formative evaluation (which should be conducted to assess the quality of the Web course instruction and interface) is often overlooked or ignored in this process. Formative evaluation involves (1) collecting a third party content expert's feedback to the instruction and target learners' experiences with the instruction and interface and (2) taking these evaluation results into consideration when revising the Web course. The purpose of conducting such formative evaluation is to further improve the Web course instruction and interface to maximize learner comfort and thus their learning outcome.

Instructional Design and Interface Design

In the ideal context of Web-based instruction development, instructional design is a process in which a content expert (the instructor), a distance learning instructional designer, and a course production team (that composes of an editor, a Web programmer, and a multimedia developer) work together developing a pedagogically sound Web course. According to the Dick and Carey systems approach model (Dick & Carey, 1996), the instructional design process involves determination of the instructional goal, analysis of the instructional goal, learner and context analysis, development of performance objectives, development of assessment instruments, development of instructional strategy, development and selection of instruction, formative evaluation, revision of instruction, and summative evaluation.

In this instructional design model, if the instructional strategy has been determined to be Web delivery, then the next stage--development and selection of instruction--will focus on the instructional content level of the Web course, such as choosing the appropriate instructional materials for the intended learners, modifying the existing format, structure and sequence of these materials to which learners are presented, and adding links to Web-based instructional resources.

The literature indicates that an important factor to the success of Web-based instruction is the integration of interface usability design into the development process (Henke, 1997). A Web course interface design defines the surface level of the Web course (that is, the visible structure that helps learners accomplish the goal of content learning). Web courses produced by using HTML coding, Web Course in a Box, WebCT, or other tools appear differently, due to their unique interfaces. An interface includes the following features:
(1) what students will see and hear on a web page within the Web browser (e.g. hyperlinks, text, images, animations, audio and video clips, streaming audio and video media, frames), and
(2) any responses (e.g. feedback, change of web page, error message) to students' actions such as clicking on a hyperlink on a Web page or the "Back" button in the Web browser.

Regardless which Web course production tool one uses (HTML coding or Web course delivery software like CourseInfo, Lotus LearningSpace, Web Course in a Box, or WebCT), it is crucial that a learner-centered Web course interface should address the goals of user-interface design: time to learn, speed of performance, rate of errors by users, retention over time, and subjective satisfaction (Shneiderman, 1998). As mentioned earlier, Wedman is concerned of students' "subjective satisfaction" of his School's on-line master's program.

Formative Evaluation

In the Web course development process, an in-house review of a Web course that can be called an alpha testing (in software engineering, the first test that is often performed only by users within the organization developing the software) consists of instructional designer's initial review and feedback to faculty, faculty's revision, editor's editing, instructional designer's review and feedback to editor, editor's re-editing, programmer's HTML coding, instructional designer's review and feedback to programmer, programmer's revision, faculty's final review, programmer's final revision. What is usually missing is the beta testing which requires a group of learners who are representatives of the target learners due to practical difficulty. Beta tests, usability tests, or formative evaluations (in the instructional design process) have one thing similar--the evaluation of the use of instruction and interface by actual learners or users.

A formative evaluation can be conducted to assess the quality of the Web course interface that includes the Web pages of general course information, and the first two lessons (if time permits, the entire course). The following is an example of an ideal formative evaluation of a Web course based on Dick and Carey systems approach model of instructional design (Dick & Carey, 1996): (1) subject matter expert evaluation, (2) one-to-one evaluation, (3) small-group evaluation, and (4) field trial.

Data Collection and Analysis

Technology plays a number of roles in the data collection and analysis processes during the formative evaluation. First of all, for the subject matter expert evaluation, the subject matter expert may live in a remote town away from the institution, so frequent travel to the institution will not be a feasible practice. As long as the subject matter expert has access to the Internet, he or she can review and evaluate the course content on the web, and make comments, corrections, and/or questions in an e-mail message sent to the instructor who developed the course. Through e-mail exchange between the subject matter expert and the instructor when discussing possible revisions in the course, the instructional designer will eventually be notified on actual changes needed for the course based on these two parties consensus.

Second, for the one-to-one evaluation, the technologies used are similar to an interface usability test. The entire evaluation will be taped by using a video camera, and the video tape will be reviewed and studied to observe the learner's facial expression, emotion changes, body language, and spoken language (while the think aloud protocol will be used) which will be also transcribed into words for further qualitative text analysis. The text analysis will make use of a software called HyperQual or a similar text coding/analysis software.

Third, for the one-to-one evaluation, small-group evaluation, and field Trial, a web-based testing software (which can be used for survey purpose) like QuestionMark Perception will be used to collect both quantitative data and qualitative data. If a 5-point Likert scale of attitude questionnaire is used, the questions can be entered in Perception. After learners complete the questionnaire, Perception is capable of conducting basic statistical analyses of the quantitative data collected such as mean scores, medium scores, standard deviations, and frequencies. Such data can be also transferred to a statistical software (e.g. SPSS for windows) for further statistical analyses or a database software (e.g. Microsoft Access) for data storage and possible future retrieval for further analyses. Likewise, if the lessons contain some form of objective posttests, Perception can be used to administer these tests, and thus results of student performance can be obtained by looking at the test/measurement analyses Perception conducted and by further analyzing the data in other software packages mentioned earlier.

Perception can also allow learners to enter open-ended information when answering attitude questions or answering subjective lesson assignment questions. The answers will be either kept on the Perception database on the web or sent to the instructor or the instructional designer for grading or evaluation. Again, for responses to attitudinal questions, the responses can be sorted or coded in a text analysis that will make use of a software called HyperQual or a similar text coding/analysis software.

Fourth, for the one-to-one evaluation, small-group evaluation, and field Trial, the instructional designer can use e-mail or phone to follow up with the learners to check on the accuracy of the designer's interpretation of their comments, suggestions, criticisms, and/or questions.

Conclusions

In order for the Web-based instruction design department to process the same number of courses with the inclusion of formative evaluation, more staff members will need to be employed, and the Web-based instruction design department will need to identify sources that can allocate such money for additional staff recruitment. If it is impossible to secure adequate funding for more staff, a compromised formative evaluation will have to be tailored (that is, to cut portions of the evaluation as outlined above) to fit the existing monetary and human resource structure.

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Implementing a Professional Development Program in Instructional Design & Technology

C. James Wong
Instructional Technology & Distance Learning, Learning Resources Division
Southwestern Illinois College
cjwong@mail.southwestern.cc.il.us

Introduction

As noted by Speziale and Kachurick (1996), "advances in technology have provided numerous opportunities for educational integration; however, inadequate professional development programs have seriously limited teachers' knowledge of techniques for integrating instructional technologies." In an effort to solve this problem, instructional technology professional development programs have been founded in many major universities and large community colleges in the United States (Stoloff, 1999).

Recognizing the emerging needs for distance learning and the integration of instructional technology, Southwestern Illinois College has launched a professional development program in instructional design and technology, an innovative service to its faculty, in the summer of 1999. The new program is operated by the Instructional Technology and Distance Learning department under the Learning Resources Division, with a mission to assist members in planning, developing, implementing, and evaluating their instruction and to facilitate innovative integration of instructional technology into their on-campus and on-line courses. This institution-specific case study describes the implementation process of this new program and reports its recent performance assessment.

Program Services and Facilities

The professional development program is led by the instructional technologist/design specialist with assistance from and collaboration with other staff members (including the associate director of distance learning, the Internet systems manager, a Web-based instruction coordinator, a Web programmer, an Internet support technician, and a network technician) in the Instructional Technology and Distance Learning department.

A. Facilities: The long-term goal of the program is to implement a faculty development facility called the "Instructional Design & Technology Center" that consists of a computer lab for training purpose and a multimedia work area for production purpose. To get things started, a computer workstation with a Pentium II dual processor has been built and is available for faculty use. Additional hardware includes: a video capture card, a flatbed scanner, a CD writer, a ZIP drive, a JAZ drive, two digital cameras, a color printer, and a laser printer. Software titles installed are Microsoft Windows NT 4.0 Workstation, Microsoft Office, Microsoft FrontPage, Adobe PhotoShop, OCR Software, and other multimedia applications. In addition, a Macintosh G3 computer has been recently included in the Center with some general purpose software such as Microsoft Office.

B. Consultation: The program offers one-to-one consultation to faculty with tailored information about theory and practice in technology applications for instruction. A customized small group session can be arranged when there are two or more faculty members interested in a certain design and technology issue.

C. Training: Hands-on instructional technology workshops on how to use various instructional software are offered to faculty, in addition to pedagogical seminars for faculty to facilitate information sharing and discussion of current issues on design, development, implementation, and evaluation of instructional technology applications.

Program Performance

A. Instructional Design Consultation: To increase the visibility of the innovation--the new professional development program, a small but concise Web site was built in the summer of 1999 to publicize the services and facilities being offered to the faculty. As words about the innovation regarding the professional development program spread out, the number of faculty who came to the program for consultation on instructional design and technology has increased:

June 1999: 1 faculty on 1 occasion
August 1999: 2 faculty on 2 occasions
September 1999: 2 faculty on 2 occasions
October 1999: 7 faculty on 14 occasions
November 1999: 4 faculty on 9 occasions
December 1999: 1 faculty on 2 occasions
January 2000: 2 faculty on 3 occasions

The average length of a consultation meeting is about two hours. It shows faculty's enthusiasm and willingness to devote their time commitment. Issues faculty members have brought to the consultation meetings are diverse. The following list demonstrates the variety of such topics:

- Developing web pages for a campus course in FrontPage
- Working with WebCT for an online course
- Discussing design issues on Social Science departmental website
- Discussing and planning a Faculty Web Directory
- Designing a welcome template for an online course
- Designing a telecourse support Web site in Frontpage
- Working with PowerPoint to develop a student orientation session

B. Training to Meet Faculty Needs: In order to understand faculty members' needs in instructional design and technology and to prioritize offerings of workshops and seminars, a needs assessment was conducted in the form of a brief survey (Dick & Carey, 1996) to 130 full-time faculty members in August, 1999. The survey included questions asking faculty to rate (on a 1-3 scale, with 3 being highly interested, 2 being interested, and 3 being not interested) their interest in a range of workshop and seminar topics derived from the text by Newby, Stepich, Lehman, and Russell (2000). 68 faculty members returned the survey. The response rate of the survey is, therefore, 52.3%. The top rated topics are listed below in the descending order of the mean of their rating:

Rating	Topic
2.27	Using presentation software in the classroom
2.24	Creating instructional web pages
2.1	Integrating instructional technology in the classroom
1.96	Using Internet communication tools
1.87	Digitizing and editing images
1.83	Lessons learned from teaching an on-line course
1.83	Creating an electronic gradebook
1.69	Fair use of copyrighted materials in on-line instruction
1.36	Introduction to distance education technologies

Meeting the faculty needs, the program developed and delivered four hands-on workshops and two pedagogical seminars till February 2000. Workshop training materials, with step-by-step instructions and screenshot illustration on how to use the software applications, were produced by the workshop trainer (who is the instructional technologist/design specialist) and pilot tested by other staff in the department. With the intention to reduce faculty's computer anxiety level and not to overwhelm faculty by teaching them every single feature of the software applications, the workshops and training materials were tailored to invite faculty members to practice some the most commonly used functions to get started. During the hands-on workshops, pedagogical issues such as design principles were discussed before the hands-on practice sessions.

The following table illustrates a brief evaluation of the training delivered from September 1999 till February 2000. The "No." column is the number of faculty who participated; the "Overall" column is the participants' average rating of the overall evaluation of the workshop based on a 1-5 scale (with 5 being the highest rating); the "Usefulness" column is the mean of their rating to the statement "What I learned in the workshop has useful applications for my classroom and/or work".

Title of Training	No.	Overall	Usefulness
Workshop - Creating Instructional Web Pages with Microsoft FrontPage 98: An Introduction	30	4.77	4.73
Workshop - Designing Classroom Presentations: Basics of Microsoft PowerPoint	23	4.87	4.96
Workshop - Designing Classroom Presentations: Advanced Microsoft PowerPoint	13	4.85	4.77
Seminar - Integration of Instructional Technology into Teaching & Learning: An Overview	15	4.13	4.40
Seminar - Interaction, Instruction, and Research Via the Internet	12	5.00	4.91
Workshop - Image Digitizing and Editing	26	4.92	4.77

More workshops and seminars are under development and will be soon offered to faculty members in the future so as to address one of the commonly complained drawbacks of a professional development program according to national findings regarding to professional development: infrequency of training (Speziale & Kachurick, 1996).

Summary

Instructional technology are great tools that offer possibilities for improving the learning process, but such possibilities will not be realized automatically unless the teacher will have to integrate these tools into the curriculum in a way to facilitate teaching and learning (Heinich, Molenda, Russell, & Smaldino, 1999). The professional development program in instructional design and technology fills this gap between the tools and the people by helping faculty use the tools to teach in a more effective and efficient manner.

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WALTS: Web-based Adaptive programming Language Tutoring System

Chong W. Woo and Jinwoo Choi
Kookmin University
861-1 Chongnung-dong, Sungbuk-ku
Seoul, Korea
cwwoo@kmu.kookmin.ac.kr

Abstract: Many recent web-based educational systems couldn't provide individualized instruction or interactive problem solving, since they are mostly built upon static hypertext. One possible solution for this problem could be adapting existing proven techniques from the stand-alone Intelligent Tutoring Systems(ITS) into the web-based educational systems. Recent web-based ITS research shows this direction by employing the existing ITS techniques minimally. And this needs to be studied further to support more adaptive instruction. In this paper we describe the development of a Web based Adaptive programming Language Tutoring System(WALTS) which is designed by ITS structure primarily, and adapting many successful ITS techniques into the system. In addition, the system adapted CORBA infrastructure to support the user more consistent and reliable performance. Together, the system behaves more adaptive and interactive than the existing static web-based educational systems.

Introduction

Many recent web-based educational systems could not provide an individualized instruction or interactive problem solving, since they are mostly built upon static hypertext. One possible solution might be adapting the existing techniques from the stand-alone Intelligent Tutoring System(ITS). However, most of the recent web-based ITS research show the efforts by employing the techniques selectively(Kay & Kummerfeld, 1994; Brusilovsky et al. 1996; Nakabayashi et al. 1997). And this needs to be studied further to enhance the overall capabilities of the system at the previous stand-alone ITS level. In this paper we will describe development of Web-based Adaptive programming Language Tutoring System(WALTS). The main goal of the development of the system is to provide the first year computer science student a comprehensive instruction for learning C programming language, by porting many successful ITS techniques into the system. In addition, the system is designed to support the user more consistent and reliable performance by employing CORBA(Common Object Request Broker Architecture) structure.

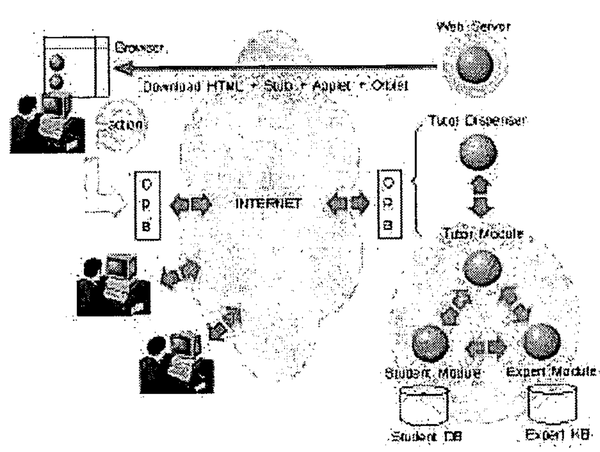

Figure1: The main Architecture of WALTS

Basic architecture of the system

The basic architecture of WALTS is designed by typical ITS structure primarily, including expert module, the student modeler module, and the instructional planning module.

The *expert* module consists of the *object-oriented knowledge base* and the *problem solver*. Since the domain of the system is the C programming language concepts, which may not require any complex causal relationships and only requires mostly simple concepts, we used the frame knowledge representation. The object-oriented approach of designing the knowledge base make it easy to understand and can provide more flexibility for updating or manipulating tutoring strategy in the construction of ITS. The problem solver creates problem table by referencing the problem template from the current *lesson unit* 's content table, which is the form of hashtable. The solver stores the correct answer, and then it presents the generated questions to the user in appropriate HTML form through the HTML generator. This method can provide different styles of questions for different users even though they are accessing the same lesson unit. Since the column name of the table is object's name, the planner can reply to the user's request, such as hint or help, by referencing this table.

The method of building the student modeler is the simple overlay. The modeler keeps all the necessary administrative information on the server, such as initial student's ID, password, e-mail address, the access time. And the information regarding the student's learning process is also stored in the student model. And each parameters has unique meanings; for example, the HelpCount, and HintCount can be updated only when the unitLesson is quiz, increase of ReferenceCount means the user is weak at the current unitLesson, the lessonLevel stores information about how many times the user visited the current unitLesson, and so on.

The Instructional Planning

The existing web based educational systems mostly employ the hypertext techniques, which is hard to make hyperlink in every HTML pages, such that it may be inappropriate for adaptive learning environment. Therefore we need to devise a method that can generate adaptive lesson unit dynamically. The instructional planning of the WALTS can be further divided into 3 steps, a curriculum planning, a lesson planning, and a delivery planning. The curriculum planning of WALTS generates a curriculum in tree structure; the curriculum planner extracts information from the knowledge base and creates a curriculum hierarchically in the order of prerequisites. Then the lesson planning sets up the lesson sequence within a single lesson unit. The role of delivery planning is limited to presenting the selected lesson content to the user.

Conclusion

The main goal of this paper is the adaptation of the existing ITS techniques to the web platform. Therefore, we have designed and implemented the system based on the major ITS architecture, and this brings us several advantages over traditional HTML-based educational systems. First, the main knowledge base is created as an object-oriented concept, which can provide more flexibility for updating or manipulating tutoring strategy. Second, the system can generate a problem dynamically by the problem solver and also can solve the problem intelligently. Third, the instructional planning mechanism can generate an instructional plan dynamically. The secondary goal is the designing of the system as a distributed infrastructure using CORBA as backbone. This structure solves the bottleneck problem of previous CGI dependent systems, and also gives some benefits of better performance and also gives flexibility in the case of further enhancement of the system.

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Online Learning Communities: Vehicles for Collaboration and Learning in Online Learning Environments

Stacey Ludwig-Hardman
University of Colorado - Denver
1583 Tabor Street
Lakewood, CO 80215
shardman@wgu.edu

Stephanie Woolley
University of Colorado – Denver
6401 S. Boston St. P105
Englewood, CO 80111
stephanie_woolley@ceo.cudenver.edu

Abstract: Online learning communities are an excellent means of integrating collaboration in online learning environments. After a brief introduction we [the authors] define collaboration and learning communities and address their theoretical foundations. We then discuss the benefits of collaboration and learning communities in online learning environments. Finally, we provide a case study of a new online learning community at Western Governors University.

Definitions and Theoretical Foundations

Learning communities are environments that encourage mutual exchange between the community members to support their individual and collective learning. Learning communities are founded on the aspect of social negotiation of meaning. Collaboration is the key tenet of constructivist and small-group theories (Springer Springer, Stanne, & Donovan, 1999; Grabinger, 1995; Duffy & Jonassen, 1992) that explains the social component of learning and demonstrates that "conceptual growth comes from sharing perspectives and modifying our internal representations in response to that sharing" (Grabinger, 1995, p. 669). Online learning communities provide the collaborative means for achieving the desired "shared creation" and "shared understanding" (Shrage, 1991, p. 40).

Benefits of Online Learning Communities

Collaborative learning and learning communities benefit learners because they encourage shared ways of knowing, promote active participation, improve achievement, contribute to the creation of knowledge, and challenge learners' cognitive abilities (Springer, Stanne, and Donovan, 1999; Moller, 1998; Lave & Wenger, 1991; Slavin, 1990).

Through new Internet technology, synchronous and asynchronous online collaboration now provides many of the benefits that exist in traditional face-to-face collaborative and learning community environments. Our recent literature review produced evidence that online collaboration and online learning communities:

- Allow learners and instructors to work together to create knowledge constructions from their combined experience (Jonassen, 1998; Reeves, 1997)
- Encourage learners to evaluate complex issues from multiple perspectives and change their perspective based on others' input (Sherry, 1998; Stone, 1996; Honebein, Duffy, and Fishman, 1993)
- Hold learners individually accountable while striving toward group goals so that students help one another and assess one another's learning (Springer, Stanne, and Donovan, 1999)
- Provide opportunities for learners to reflect on their learning experiences and upon others' input (Stone, 1996)
- Demonstrate that meaning and reality is socially constructed and negotiated through the exchange of ideas, information, and feelings among the members of the community (Hiltz,1998)
- Improve student achievement through increased motivation, peer support and communication, and commitment to participate and finish (Hiltz, 1998; Sherry, 1998; Stone, 1996)

The above evidence demonstrates that online collaboration and online learning communities can impact and enhance the learning process. We have personally witnessed the impact of a self-initiated online learning community at

Western Governors University. Although the WGU online learning community is relatively new, we have already seen positive effects ripple through the community members.

Case Study of an Online Learning Community at Western Governors University

In August 1999, Western Governors University (WGU) began enrolling students in its new competency-based Master of Arts in Learning and Technology program (MLT). A cohort of 50 students, primarily K-12 teachers, geographically dispersed throughout Utah were some of WGU's initial MLT students. In October 1999, a small group of 15 cohort students created their own collaborative online learning community utilizing a listserv since all students had ready access to e-mail.

The WGU online learning community provides a fascinating case study because it was initiated by the students themselves who by and large had no previous experience working together. Of the 15 original members of the community, only five had previous experience working with each other on previous projects; the majority of the learning community members had only met each other briefly at a WGU reception in September 1999.

As we watch the WGU online learning community develop, we are paying attention to the ways that the community members negotiate roles and establish rules and standards for communication, interaction, and entrance into the community. We are eager to compare learning community members' performance to the performance of students who do not participate in the online learning community. We are also interested in determining why some learning community members remain inactive or decide to leave the community.

Conclusion

Salomon and Perkins (1998) state that "learning to learn... fundamentally involves learning to learn *from* others, learning to learn *with* others, learning to draw the most from cultural artifacts besides books, learning to mediate others' learning not only for their sake but for what that will teach oneself, and learning to contribute to the learning of a collective" (p. 17). Collaborative online learning communities provide community members the chance to learn *from* and *with* others and to *contribute* to others' learning. As a result, they are important means of integrating the social aspect of learning into online learning environments. Our literature review and personal research of the WGU online learning community provide valuable insight into issues surrounding online collaboration and online learning communities' development, communication patterns, member roles, rules, flexibility, sustainability, and reproducibility.

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Developing Collaborative Technology-Enhanced Programs To Create Learning Communities

Nancy Wyatt
njw@psu.edu

Matthew Bodek
mjb14@psu.edu

George Franz
gwf1@psu.edu

Karen Hill
klh7@psu.edu

Susan Ware
saw4@psu.edu

Penn State University Delaware County
25 Yearsley Mill Road
Media, PA 19390
United States

Abstract: Encouraging effective collaborative learning supported by computer technology requires coordination among faculty, administrators, technical and instructional support staff, and library staff. This paper describes the roles of each of these groups in the design and use of computer technology to support collaborative learning. This paper draws on collective experience from implementing Project Vision and Project Empower, two computer-supported collaborative learning programs in Commonwealth College, Penn State University.

Too often the discussion of collaborative learning and use of computer technology to support instruction focuses solely on the classroom; in fact, successful efforts in the classroom rest on a foundation of collaboration and support from administrators, technical and instructional support staff, and library staff. Over the last several years Penn State University Delaware County has developed teaching methods that incorporate the best features of distance education and collaborative learning in undergraduate education. The two projects most directly responsible for the development of collaborative, technology-enhanced instruction were Project Vision and Project Empower, both programs for freshmen and sophomores in general education courses.

Administrators

Important administrative support issues include motivating, training, and supporting faculty to take on new teaching roles and new responsibilities, since collaborative teaching and use of computer technologies differ significantly from the standard lecture/discussion format. Administrators must make sure that the reward system for faculty recognizes the effort necessary to change from the old to the new model; we provided release time and training for faculty to learn new roles. Administrators are also responsible for making sure that appropriate equipment and software for courses is installed properly and works efficiently. Persuading faculty to work cooperatively with librarians and with technical and instructional support personnel is also an administrative role. Administrators may also be responsible for the selection and orientation of technical and instructional support personnel, who must understand the academic mission and the instructional process. Finally, administrators must be well versed in designing and conducting collaborative learning in technology-enhanced classrooms, because they are responsible for the evaluation of the quality as well as the economic viability of these efforts.

Faculty

Graduate training seldom includes a component on teaching collaborative, technology-enhanced courses. Hence, faculty must learn how to design, manage, and evaluate collaborative assignments, as well as how to choose appropriate technologies to enhance learning in their specific venues. Faculty must be expert users of the technology in order to explain the technology to inexperienced students who are struggling concurrently with course content. Faculty always balance the advantages of new instructional media against many constraints, including the students' abilities and interests, classroom facilitics, and thc quality of technical support. They must also balance the time they spend in these activities against other responsibilities of teaching, service, and research. Computer technologies are constantly changing; therefore, faculty who are committed to these pedagogies know that the process of learning new technologies and the balancing act are never-ending.

Technical/Instructional Support Staff

Technical and instructional support staff work with faculty from a wide variety of disciplines, as well as with administrators and students. Math, social sciences, humanities, and business all have different content and different pedagogies. Technical and instructional support staff must understand a wide variety of technologies and software programs appropriate for specific disciplines to help faculty make informed choices. Support staff often advise faculty in designing assignments that make the best use of collaboration and computer technologies. Technical and instructional support staff must understand students' abilities and interests in order to recommend the most appropriate technologies for each particular instructional situation, keeping in mind budgetary constraints. They train faculty and students and trouble-shoot daily problems which inevitably arise. Close collaboration with faculty, administrators, and students requires superior communication skills. A sense of humor doesn't hurt either.

Library Staff

The new technology-enhanced and collaborative classrooms are changing the roles of librarians as well as faculty. Library staff must constantly keep up to date with emerging technologies, a not inconsiderable task with the rapid development of electronic media. Librarians are responsible for designing systems for accessing information that make sense to users. Increasingly, librarians find themselves acting as coaches and collaborators for instructors who are learning to teach in collaborative and technology-enhanced modes. Library staff also train, coach, and support students in learning to use search technologies to find information. Library staff share responsibility with faculty for teaching critical thinking skills as they teach students to evaluate the quality and usefulness of the information students are using.

Conclusions

Commonwealth College of Penn State University created Project Vision to encourage faculty to redesign courses to incorporate collaborative and active learning strategies supported by appropriate technology in teaching undergraduate education courses. The administration offered release time, extra compensation, and training to prepare selected faculty for the pilot program which was designed by faculty. Over the four years of this program, the faculty tried several models for offering courses. Once all the students took only Project Vision courses for the first year as a cohort; in other years, students took some Project Vision courses and some regular courses. For two years, the faculty offered courses coordinated across two different locations. Usually, the courses were offered as a package. For example, students took Speech Communication to learn how to work in groups, Library Studies to learn how to do research, and Health Science as the content of the research project. The technologies included FirstClass computer conferencing, Eudora e-mail, PowerPoint, and video conferencing.

Synchronized Notes for Digital Class Video

Michirou Yabuki
Faculty of Informatics, Meisei University, Japan, yabuki@ei.meisei-u.ac.jp

Akira Watanabe
Faculty of Informatics, Meisei University, Japan, akira@ei.meisei-u.ac.jp

Introduction

We proposed a method using digital class video for review and self-studying and applied it to some subjects. We believe our method is successful in actual education. Students will make their own notes watching digital class video in the same way they make their own notes during ordinary classes. If students watch digital class video for their study many times over, their notes will be essential. In addition to digital class video, we propose synchronized notes for digital class video.

Digital Class Video

In many educational organizations, networks are used for educational support. On the other hand, there are many traditional classes that have no educational support using computer networks. When one intends to utilize computer networks or the Internet for traditional classes, he/she will suffer from various problems such as time for investigating teaching materials, manpower, arrangements of equipment and preparation of presentation data.

To solve those problems, we proposed a method using digital class video for introducing educational support utilizing computer networks for traditional classes. Our five goals of the proposed method are: the purpose of the method is review and self-studying; the method could preserve the various teaching style of teachers; the method should be simple so that the number of staffs and a budget should not be large; the method is able to be adopted to traditional lectures and computer exercises; more than one simultaneous classes should be supported using the method.

To achieve above goals,

- The scene of a class is recorded on video tape as it is.
- The camera for recording teacher's movements has fixed view and never follows of teacher's movements.
- A written material or a computer screen of the teacher operates is also recorded on another video tape.

These two videos are synthesized to a single image for publication.

As experiments, we applied our proposed method to five subjects in 1998. The experiments are still continued in 1999. The number of total access times to the video was 1300 in 1998. We believe that our educational assistance method is successful.

Synchronized Notes

To study subjects, just watching class is not enough for studying. Students ordinarily make notes on class with a notebook and a pen. (Nowadays, some students use their own lap-top computer for their notes in classes.) When students watch class video on the computer, it is preferable for students to make notes on the computer. To make notes on the computer while watching digital class video is simple because they can easily use another window for a text editor or something like that. In that way, students are able to review their lessons again, by watching video and their notes. As Notes is, however, "static" information, students should synchronize notes and video by themselves during watching video.

To synchronize notes and video, we implemented a telop function to our MPEG video viewer software. Users are able to put comments or notes to video as a telop just when they are needed. Once users put comments or notes to video, the telop come up on the screen at the designated time whenever they watch video. Fig. 1 shows an example of telop function.

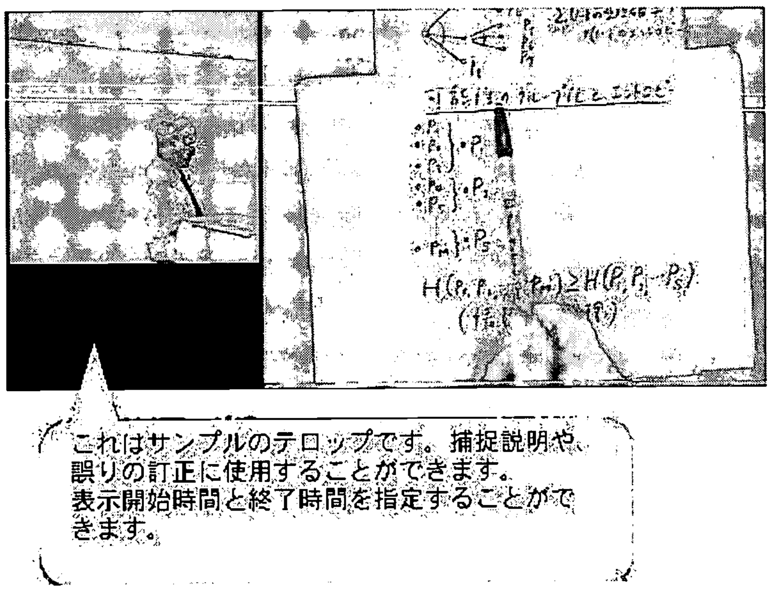

Figure 1. An example of synchronized notes

If user put comments to video, a mark is shown on the scroll bar so that users are able to find where they put their comments. Scroll bar of the MPEG viewer is used to forwarding and rewinding video.

The mark on the scroll bar is also used to find important points of the video. In our method, the entire class is recorded on the video. Usually teachers use a lot of time for thinking, joking or something like that. The mark is used to avoid overhead of watching unnecessary parts of video.

In the same way, not only users (students) but also teachers are able to put comments to video. After the class, teachers sometime notice there were mistakes or insufficient explanation during the class. In such case, teachers are able to add additional explanation or corrections to video as a telop.

Conclusion

We implemented synchronized notes to MPEG viewer. Users are easily able to add comments and notes to class video for their self-studying. After the class, teachers are also able to add additional comments or explanation to their class video. The softwares are implemented as WindowsNT and UNIX (FreeBSD) X-window applications so that students are able to study on any plathome.

Acknowledgement

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The Development of Multimedia Kanji Dictionary for Non-Japanese on WWW

Kazuto YAMADA, Shinichi FUJITA, ChunChen LIN, Seinosuke NARITA
Department of Electrical, Electronics and Computer Engineering,
School of Science and Engineering Waseda University, Japan
Narita lab, Sci. & Eng., Waseda University 3-4-1 Shinjuku-ku Okubo, Tokyo, 169, Japan
kazuto@narita.elec.waseda.ac.jp

Abstract: In recent years, popularized technologies such as "Multimedia" and "Internet" came to be used in various fields. The field of education is not an exception either, and these technologies are adopted by CAL (Computer Assisted Learning). Especially, the successful introduction of these technologies into Japanese education is being looked forward to. Since Japanese as the 2nd language is said to be high in the degree of difficulty in acquisition, an improvement in the study efficiency through adopting such technologies is expected. This paper focuses on Kanji of Japanese language education and discusses the multimedia Kanji dictionary.

Introduction & Background

At present, there are many non-Japanese who are learning Japanese in the world. However, with a limited time allocated for study in classes, the present condition does not offer sufficient education for mastering Japanese. For, not only are there problems related to the basic grammar such as the word order in Japanese is sometimes different and the use of the auxiliary verb is more complicated in comparison with other languages but also there are three kinds of characters used: "Hiragana," "Katakana" and "Kanji." Especially, quantity in Kanji is voluminous and the shapes are complicated. Even for Japanese, it takes 6 years to learn over 1000 Kanji characters. Furthermore, so much information is contained in Kanji (for example, reading, meaning, radical and the stroke count, etc.). Therefore, the more efficient Japanese education system is necessary because it is excruciating for people in the countries where Kanji are not used to learn them in a short period of time. When people in the countries where Kanji are not used learn their mother tongue, they emphasize "conversation." Therefore, even when they learn Japanese, they emphasize "conversation." In comparison with Japanese, a one byte code language, in the first place, has a fewer number of characters but has a number of types of pronunciation. Therefore, such a language can be mastered mainly by improving conversation ability.

From such a reason, for people of the countries where Kanji are not used inevitably neglect learning of Kanji. To effectively learn Kanji, the multimedia Kanji dictionary was developed. Since the electronic dictionary facilitates the understanding of Kanji by using animation and sound, it can improve learning efficiency much more than a conventional paper dictionary. Also, the characters of the index are so small that we sometimes become fed up with looking up Kanji in the paper dictionary. However, people will become able to search Kanji more easily by just clicking if they use the multimedia Kanji dictionary. This electronic dictionary is functioning as the dictionary module of an integrated Japanese learning system called "Terakoya."

URL: http://www.narita.elec.waseda.ac.jp/~fujita/terakoya.html

Kanji Dictionary

This dictionary system can be divided into the Kanji searching part and dictionary database part. In the searching part, there are three kinds of functions "Read," "Stroke count" and "Radical." Here, we can find a Kanji character for which we are searching, and we can read out detailed information from the dictionary database that is stored as a CSV file. On the one hand, this system contains detailed information such as radicals and the stroke count for people who want to learn detailed information. On the other hand, this system facilitates easy learning of Kanji by including items for children such as pictures and figures that look similar to Kanji. This system has become an interactive system that has more mobile capability by using animation and sound, which is in contrast to the conventional dictionary system that emphasized text data. Animation is used to display the order of strokes of a Kanji, and voice is used to let the learner hear the data of "Reading" and "Examples." Furthermore, in order to have the users learn a large quantity of Kanji, this system understands Kanji through graphic means by recognizing each Kanji as a picture or a figure to improve learning efficiency.

And, because this system is using WWW, it is not dependent on a particular type of platform. A learner can use it through the Internet from PC regardless of whether the person is at home or in a class. Even if there was no such environment, in such case information of Kanji can be read by printing the contents out on paper as a conventional dictionary. Although this system is developed with Shockwave of Macromedia Company, the browser is not able to function as a printer when the movie that was made with Shockwave is loaded into the browser. Therefore, a page where Kanji information is transformed into an HTML has been made. If the hard copy of Kanji information can be made, it can be used at places where there is no computer nor a network environment. This function comes from the requests of the Japanese language teachers and also of Japanese language learners.

Future Plans

Although this dictionary system has searching functions of "Read," "Stroke count" and "Radical," these searching methods are used conventionally in the conventional paper dictionary. However, there must be cases where a beginner of Kanji learning has no idea about the reading, the stroke count nor the radical of the Kanji that he/she wants to find out. To this end, we are studying the functions by which a Kanji can be searched through handwritten letter recognition. If this searching method is created, a learner can search for the Kanji by the action that is similar to drawing a picture of the Kanji whose detailed information is not known to the learner. Also, although the present system has registered 80 Kanji characters in the database, in order to maintain coordination with the "Terakoya" system, it is necessary to classify Kanji by the degree of difficulty or by the use frequency in daily life to offer data to the user in an easy-to-understand manner. Furthermore, because there are some cases where the requests of teachers differ from the contents of a dictionary, we should add such function that enables the teachers to freely select the words and pronunciations, etc. that he/she wants to use in the lesson. If there is such a function, a lesson will become very effective. At last, we need to evaluate this Kanji dictionary. This system will be tested by the Center for Japanese Language of Waseda University and the Richmond school in Portland. And, we want to advance to further improvement by asking advices from teachers and students.

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Teaching On-line Versus On-site: A Study of Instructional Delivery Modes in Foreign Language Education

Quan Yang
Distance Learning, Troy State University Dothan
qyang@tsud.edu

C. James Wong
Instructional Technology & Distance Learning, Learning Resources Division, Southwestern Illinois College
cjwong@bacnet.edu

Abstract: The purpose of this study was to identify the similarities and differences of online and traditional foreign language courses and to determine the advantages and disadvantages of the online courses. Using a random sample of 20 courses, ten on-line and ten traditional, this study examined the online and traditional courses in terms of five constructs and compared the methods and strategies used in online courses with regular classroom instruction. With a rubric developed for the study, the online and traditional course were rated in a 4-point scale and analyzed with independent t-tests. The findings of the study indicated that online and traditional courses had about the same weight in teaching foreign language and suggested that they each had its advantages and disadvantages. The study concluded that traditional courses had better defined and more specific goals and objectives for both teaching and learning and was more effective in teaching conversation and listening comprehension, while in online courses, students could learn at varying rates and explore material to whatever depth they desire, and Internet technology made it possible for students in different areas and from different countries to access online courses.

Introduction

With the rapid development and fast growing adoption of technology, the use of technology in education has been dramatically increasing over the past few years. In the area of language education, various technologies are being utilized by language teachers and learners in and out of the classroom (Warschauer, 1996). These uses would include the traditional use of audio and films; however they are now being supplemented by computer-assisted instruction and interactive media technologies (Richards, 1996). Computer-based programs, as well as other computer-related interactive technologies, have been specifically developed to provide students with visual and audio support. These applications have shown potential for helping students develop their language abilities and improve classroom performance (Pennington, 1996).

Among a variety of instructional delivery media, the Internet, especially the World Wide Web, has been commonly adopted by many educators in higher education (Khan, 1997; Porter, 1997). However, little research results have shown to support claims for the effectiveness of Web-based instruction (Nunan, 1999). The focus of this study was an analysis of existing web-based foreign language courses and a comparison of the methods and strategies used in online courses and regular classroom instruction to determine the common and unique methods and strategies used to achieve the educational objectives in each environment.

Purpose of the Study

The purpose for conducting this study was to identify the similarities and differences of online and traditional courses of teaching foreign languages and to determine the advantages and disadvantages of the online courses. Methods, strategies, and technologies used in online foreign language courses were examined and compared with those of the traditional foreign language courses. In order to achieve the purpose of the study, the current study addressed the following research questions:

1. Based on the courses examined, what methods, techniques and strategies were used for teaching online foreign language courses and traditional foreign language courses?
2. What were the differences between traditional foreign language courses and online foreign language courses in terms of goal/objectives, strategies, interaction, feedback, and resources?
3. What were the advantages and disadvantages of the online courses?

Method

The sample for this study consisted of twenty foreign language courses, with ten on-line courses and ten traditional courses. Thirty online courses were first identified directly from foreign language courses available on the Internet, which included listening, speaking, reading, and writing courses. The following systematic procedure was used to randomly select ten courses from the thirty previously identified online courses: First, a random list of the thirty online courses was generated. Then a start point for the selection was randomly chosen on the list. From that point every third course was selected until a total of ten online courses were identified for the study. Among the ten courses that were chosen were two listening courses, one speaking course, two reading courses, two grammar courses, and three writing courses.

With the same procedure, the ten traditional courses used for this study were randomly selected from foreign language courses offered by the Intensive English Programs and foreign languages departments at various universities. The course materials of these ten courses were available at the University of Louisville, the University of Alabama, Southeast Missouri State University, and North Carolina Wesleyan College. They were three listening courses, two speaking courses, two reading courses, one grammar course, and two writing courses, which comprised the traditional foreign language course group for data analysis. With a rubric developed for the study, the online and traditional course were rated on a 4-point scale and analyzed with independent t-tests.

Results and Discussion

The comparison by means of the rubric indicated that the online courses and the traditional courses had about the same weight in teaching foreign languages in general. Online courses had a total score of 147, while the score of the traditional classroom teaching was 153. However, the independent t-tests, which were performed to identify any possible significant difference between the online and traditional courses, found that significant differences existed between the two types of courses in two of the five constructs measured.

Conclusion

A foreign language acquisition process consists of listening, speaking, reading, and writing skills. In order to facilitate the success of second language teaching and learning, modern technologies have been used in the classroom to promote teaching performance and student learning. Online courses, which have been developed for that purpose, have proved their advantages in foreign language teaching and learning. However, when comparing traditional classroom teaching with online courses, the results of this study suggest that each had its advantages and disadvantages. For traditional courses, better defined and more specific goals and objectives were given for both teaching and learning. Delivering course material through the Web, on the other hand, afforded some advantages over traditional classroom teaching. In online courses, students could learn at varying rates and explore material to whatever depth they desire. There were new ways to guide students through tutorials and to provide them with instant feedback. Using Internet technology made it possible for students in different areas, different countries to use varying computer types to have access to the course.

However, as far as a foreign language is concerned, it is obvious that traditional classroom teaching was better in teaching conversation and listening comprehension courses when students needed face-to-face interactions with the instructor and instant verbal feedback from the instructor. Computer-mediated communication had been criticized as lacking the human social interaction necessary for human learning (Gilbert, 1996) although Lemke (1993) claimed that "cyberspace will be a virtual place FOR human social interaction." It seems that web-based courses might not be able to provide as effective or efficient a means of learning a language as one-on-one human interaction. Without such non-verbal cues as body language and the tone and pitch of one's voice, it is possible to misconstrue messages (Berge & Collins, 1995; Gilbert, 1996).

In summary, neither of the two types of courses is absolutely good or faulty. Each had its own advantages and disadvantages. As an instructional designer, we should be aware of the advantages and disadvantages of both types of courses and make full use of their advantages in the design and development of the courses, based on different student needs, student characteristics, and skill requirements, to achieve the goals of our education.

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The Road to Hell Or Wrong Turns on the Path to Cyberlearning

Stephenie Yearwood
Lamar University
P.O. Box 10023
Beaumont, TX 77710
Steffiy1@aol.com

Paula Nichols
Lamar University
P.O. 10034,
Beaumont, TX 77710
pnichols@tenet.edu

Abstract: The paper proposes and explains five common mistakes which institutions often make in implementing distance education: using packaged courses and low-level instructors, using one technology to deliver all distance education, not monitoring student satisfaction and retention, assuming that all courses can and should be offered via distance technology, and focusing marketing only on the technology-literate.

Racing along the Road

The shape of distance education is changing daily as more and more institutions embrace the technologies now available to deliver remote instruction. One estimate by Robert Tucker (1997) quoted recently in Forbes, is that about 90% of US four-year institutions will have technology-based distance learning offerings by 2000. Even in 1996, over a million students took distance learning courses of the 14 million attending post-secondary educational institutions. And, although these courses use many different technologies, there is rapidly-increasing focus on internet delivery. In this rush to get on the bandwagon, the authors, who have been involved with emerging distance education in Texas for the last ten years, have observed several common assumptions which cause great concern. The focus of this paper will be to identify and call into question some frequent phenomena which, we believe, threaten to undermine the success of cyberlearning.

Wrong Turn One: Buy a packaged course and hire a TA or two to run it

One of the driving forces behind the charge to cyberlearning is the common perception that cyberlearning will be a cash cow for traditional institutions, allowing them to cut costs. In a rush to milk, institutions are sometimes choosing to dispense with home-grown courses run by local professors. This choice threatens to result in a world of cyberlearning where there are many institutions to choose from, but all are teaching the same course. Losing the personal enrichment, the personal mentoring and the constant updating which an experienced teacher puts into a course is equivalent to losing the personal voice or identity of an institution. Cyberlearning should increase the diversity of the educational ecosystem, not decrease it.

Wrong Turn Two: Buy one technology and use it for everything.

Because the costs for establishing technology-based distance learning can be large, institutions are prone to make an initial commitment to a technology (VHS with two-way audio, or TV, or compressed video, or web) then force all course offerings to fit themselves to that technology. Institutions have been known to simply buy whatever was pitched to them most intensely in the hopes of not having to face the bewildering array of choices again for quite some time. However, close analysis of student needs, course content, and educational effectiveness has led us to believe that hybrid technologies evolved over time and respondent to individual courses and student audiences produce superior educational results. Educational needs and goals should drive technology, not vice versa.

Wrong Turn Three: Don't worry about student satisfaction; the learning is fine

Indeed, much past research on distance learning using all kinds of different delivery modalities from correspondence courses to web has indicated that students seem to learn as much from distance courses as they do from face-to-face instruction (Russell 1996). However, we cannot ignore that cybercourses vary enormously in learner-satisfaction and quality. In an ideal educational cyber-marketplace, learner-centered course design will eventually prevail. Courses which use technology well and flexibly to deliver their course content and achieve course goals, and courses which attend to a wide variation in student learning styles will have better success. Convenience of access is not enough; quality matters, too.

Wrong Turn Four: Move everything onto the cyber-track.

With the emergence of virtual universities and entire degree plans available by remote technology, the instinct of many institutions is to think of distance learning offerings as a substitute for face-to-face instruction, rather than an adjunct to it. However, a closer look shows quite clearly that cyberlearning has, thus far, leaned heavily in the direction of engineering, business, computer science and health sciences. (Miller 1998). According to Miller, all other subject matters account for only 10% of cybercourses. In spite of the pronouncement of Peter Drucker (1997) that "Universities, as we know them, won't survive," almost all lower-division and humanities courses continue to be offered in traditional fashion. One reason for this, we believe, is the need for greater flexibility in adapting to the goals of such courses and the needs of students. Cyberlearning should, we believe, offer additional choices to students and teachers--not force them into a course-delivery system alien to them. In fact, we go so far as to argue that cyber courses should, in most cases, have live, face-to-face versions running, too.

Wrong Turn Five: Just market the courses and the students will come

Certainly convenience, accessibility, and low cost are strong incentives for students to engage in cyberlearning. However, issues of equity and market penetration will become ever more pressing as institutions seek to draw increasing numbers of students. Access to computers is increasing daily, as is internet access; however individuals without home computers or internet access may be precisely the ones who most need access to "anytime, anywhere" post-secondary education. Institutions must attend to insuring access at public libraries, K-12 schools and community centers in order to insure equity for all ranks of society and to avoid widening the digital divide. Moreover, some segments of the market will need additional technology training in order to effectively use the access which is available to them, and institutions must provide appropriate training in technology if they are to draw high-school dropouts and retired persons into cyberlearning.

In a dynamic growth period such as we face now, the drive to implement cyberlearning will benefit many students and institutions, but only if decision-makers tread the path thoughtfully and with their eyes open for wrong turns.

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Dynamic Learning Patterns: Temporal Characteristics Demonstrated by the Learner

L. Roger Yin
LEARN Center/Graduate Studies and Continuing Education
University of Wisconsin-Whitewater
United States
yinl@mail.uww.edu

Abstract: This paper sought to identify learner-demonstrated learning patterns when undergraduate students were learning to use a computer-based presentation program in a multimedia learning environment without time constraints. Using analysis of patterns in time (APT), a methodology that can code event changes over time, the frequencies and the amounts of time of the five learning patterns were calculated. The data derived from the APT scores indicated two major findings: (1) The amount of time used by the participants ranged from 20 to 87 minutes. The amount of time spent did not predict mastery of the post test. (2) 'Following through error corrections', 'confirming actions', and 'trying new steps' were the patterns that did appear to predict mastery, and 'hand on mouse' and 'keeping up step-by-step with the video instruction' were indicators of learners' task engagement. The findings suggest that it is important to design flexible instruction to facilitate repeated, persistent, and successful practice in order to achieve mastery in a self-paced, computer-based learning environment, regardless of the amount of time spent.

Iotroduction

This study sought to investigate the existence of any significant temporal patterns of learner-demonstrated sequencing as learning styles that are related to the mastery of learning a procedural computer-based multimedia task.

The impact of how different learning styles affect human learning has concerned educational researchers for decades (Bruner, 1966; Gagné, 1967; Kolb, 1984; Wang and Walberg, 1985; Tobias, 1981, 1987). According to Cronbach and Snow (1977), learning style can be used to predict what kind of instructional methods or strategies would be most effective for a given individual and learning task. Such attempts to discover the predictors for content mastery were typified in Aptitude Treatment Interaction (ATI) research. In ATI studies, aptitude was defined as any learner characteristic related to instructional outcome, and treatment was defined as any variation in instruction to the learner (Cronbach and Snow, 1969). However, research to date on this problem has not identified many robust relationships between learning style and instructional method that are needed in order to generalize the assignment of instruction to different learners (Snow, 1989). Could this lack of robustness be caused by overlooking the means in favor of the ends of learning? Or perhaps the notion of aptitude needs to be defined differently when the means of learning (or learning process) is considered as a critical component in a learning experience.

Frick (1990; 1992) indicates that one of the fundamental problems of ATI is that the linear model approach (LMA) employed by ATI cannot explicitly demonstrate the different means of learning because the LMA was designed to estimate parameters of mathematical models and is not adequate in dealing with occurrences and relative frequency of temporal events. LMA is best for explaining the relation between two or more independently measured variables, but it cannot measure the frequency or duration of occurrences of a temporal path (Frick, 1983). This observation directly implies that there is a need for a methodology other than LMA when we investigate the temporal patterns in a learning process, especially with a concurrent attempt to examine aptitude in a different way.

Learning takes time. Learners take different amounts of time to perceive information in order to acquire knowledge. Knowledge is actively constructed through temporal sequencing of meaningful interactions between the individual and the learning context (Piaget, 1973; Dewey, 1916; Bruner, 1973; von Glasersfeld, 1991). But how can we move the learning-styles research away from the instruction-centered "how one should learn" to the learner-centered "how one does learn"? In order to make instructional systems more adaptive, researchers need to put more emphasis on learner-demonstrated learning styles, where the relationships between the sequencing, time duration, and nature of the media should be carefully examined. This need is especially important now that multimedia, productivity software programs, and the explosive growth of the Internet have entered our educational settings and homes (Nielsen, 1995), and the technological capabilities have caused us to reconceptualize the learning process and to design new instructional approaches (Duffy and Jonassen, 1992).

To understand the need to redefine learning styles, it is necessary to comprehend the nature and limitations of conventional learning styles. Sewall (1986) compares four popular instruments to measure learning styles: the Myers-Briggs Type Indicator (Myers, 1962), the Kolb Learning Style Inventory (Kolb, 1976), Canfield's Learning Style Inventory (Canfield, 1980), and Gregorc's Type Indicator (Gregorc, 1984). He finds that all of these instruments fall short generally in four areas: (1) no appropriate normative base for the valid interpretation of scores; (2) limited validity due to construction problem with the instruments; (3) reliability estimates are unstable, though one can argue that the dynamic nature of learning style makes high test-retest reliability unnecessary; (4) the normative frame of reference makes the interpretation of scores very difficult. Among his suggestions for future research, one suggestion particularly interests the present writer:

"Future research could also explore the issue of whether an individual's preferred learning style is modified by the educational environment. For example, do adult students learn better when instruction is adapted to their learning style preferences? Can people be trained to adopt a particular learning style? Do learning styles remain stable over time in the adult population? Does a significant change in life situations result in changes in learning styles?" (p.61.)

It is interesting to notice that all four of the above-mentioned learning-style instruments use lists of verbal statements or different visual forms prepared for people to choose or rank. This isolated "one size fits all" approach is decontextualized and artificial, and apparently biased on language skills and cultural backgrounds. The predefined assessment tools require people to fit in the limited and selective choices with "I think this is who I am" or "I think this is what I will do or how I will react," which may not predict how one actually reacts to or interacts with a problem in a specific learning situation. This predetermined and convergent assessment approach may be the fundamental reason that only limited reliability and construct validity have been found in existing learning-style studies.

Maybe, as Sewall suggested, human learning styles are constantly modified by the educational environment and social context and are too dynamic to measure on a predetermined and predictable scale. This notion leads the present writer to believe that to survey fully the dynamic nature of learning styles, rather than using artificial instruments, we can observe and faithfully record the event changes of a learner-demonstrated process over time. In other words, the result of this study may not verify that learning style is a stable trait (Bateson, 1979).

Researcb Questions

1. In the midst of the information explosion, multimedia has become the new learning environment. Learning how to interact with multimedia-based information or instructions has become our daily experience. It is important to note that multimedia is a combination of three forms of content: (1) abstract (e.g., verbal -- either text or audio -- explanation in a computer program window), (2) iconic (e.g., the screen capture of a computer program window printed on paper), and (3) concrete (e.g., the actual computer program windows displayed on a monitor screen). The main questions addressed in this study were as follows:Given the choice of instructional materials in different forms of content, what learning sequences are selected by the learners?

1.1. If the sequences differ, how do they differ?

1.2. Are any of these sequences especially likely to result in overall mastery?

1.3. Is there a difference in the amount of time spent learning for those learners who achieved mastery and those who did not?

In order to increase both reliability and validity in identifying the learning patterns (Denzin, 1970; Foreman, 1948), a triangulation method was used that involved observation of the learning process and think-aloud interview. "Triangulation" is to use multiple methods in data collection (Denzin, 1970). Merriam (1988) indicates that "methodological triangulation combines dissimilar methods such as interviews, observations, and physical evidence to study the same unit." An observation system designed and based on the analysis of patterns in time (APT) approach was used to code how and how long students use and switch the instructional materials, and their engagement during the processes of learning. Both the learning processes and the think-aloud interviews were recorded on videotapes for examination and analysis.

Twelve participating students from a midwest regional university were selected through a screening process using Kolb's Learning Style Inventory (Kolb, 1976) where three students were selected extreme cases in each of the four learning styles identified by Kolb (converger, accomodator , diverger, and assimilator). The participants were expected to create three electronic slides using Astound, a multimedia presentation software, during the learning process. They were told that there was no time constraint and that they could freely use the printed jumpstart instructions, the video demonstration parallel to the printed instructions, and the user manual and tutorial. They then created a fourth slide without instruction as the post test. Learning sessions were recorded on video, and participants subsequently watched their own videos and were interviewed using think-aloud methodology. Multiple observers watched the videotapes of the learning performances for patterns of interaction, which were illuminated by the think-aloud interviews.

In this study, the interview was semistructured. The interviews followed the observations, hence the interviews supplement and complement the outcomes of the observations, rather than forming a different set of data not related to that from the observations. The questions asked were open-ended so the students could explain fully and interpret any specific events that occurred in their learning performance.

As soon as the raw data from the interviews were collected, the data gathered from both the observation and the interview on each student were arranged into one case for analysis. As Merriam (1988) suggests, the "simultaneous analysis and data collection allows the researcher to . . . develop a data base that is both relevant and parsimonious."

Next, the data collected from both the observation and the interview were sorted into any repeated patterns that are common to more than one person or identifiable categories or themes. Some patterns and their variations were spotted faster than others. Some unexplainable events or sequences from the observation were explained when data from the interview were reviewed and compared. This step was repeated until all 12 cases were analyzed. Then, an analysis to reduce and refine the categories or patterns among the cases was conducted.

Result

The narrative temporal descriptions of each of the 12 cases were compiled. The descriptions included answers to the following questions: Who was the person (age, gender, race, academic major, Kolb's learning style, mastery of the post test, prior computer experience). What did s/he do with the instructional materials during different parts of the learning session? What comments (direct quotes from the think-aloud videos) did the person make about what s/he was doing? These thick descriptions (Lincoln and Guba, 1985) illustrated how the participants actually interacted with the instructional materials during the learning sessions. These thick descriptions (Lincoln and Guba, 1985) illustrated how the participants actually interacted with the instructional materials during the learning sessions. To demonstrate the uniqueness of these participants, the following is a complete set of descriptions recorded from one of the 12 students.

Student F

Student F was a twenty-two-year old white male. He majored in Secondary Education and had had four years of computer experience. He was a converger (with a tendency toward active experimentation and abstract conceptualization), according to Kolb's learning style. He was judged a master of the post test. He spent a total of 42.5 minutes in completing the learning tasks and the post test.

Student F spent nine minutes on Task #1. He began his learning session by playing the video demonstration while reading the instructions. Student F is rather reserved but well-mannered. Of his choices of instructional materials, he said, "I didn't mind it. I like to have something to follow along with [the printed instructions], and I can stop [the video] whenever I want, so that makes it a lot easier for me." When asked how he used the instructional materials, he answered, "I started by reading the [printed] instructions and watching the videotape step-by-step. But after a while, I was not even watching it, 'cause I know pretty much what to do by listening to it." He said of his reading strategy, "After a while, I was just reading ahead, and make sure that I wa instructions, "I could have gone faster", he said, "but I just wanted to cover all three [video, computer, and printed instructions] to make sure I am not doing anything wrong."

Student F spent eight minutes on Task #2. He continued to follow the video demonstration while reading the instructions. He noted that he did not use the manual, "I didn't use the book [the user manual]. It was kind of complicated. Your language may not add up to the technical language they use. It is better to have these kind of materials [the printed instructions] that are more specific." He said of recovering from a mistake, "When I made that mistake, I was not watching the video. I just remember how to put a 'Next' button and I just did it." On how he checked with the instructional materials, he noted "After a while, I was just checking [with the instructions], though I wouldn't go word for word."

Student F spent nine minutes on Task #3. He continued to follow the video demonstration while reading the instructions. He said he had his hand on the mouse because "I think I was just getting ready for the next step." When asked what if he were not given the printed instructions, he replied "I wouldn't have read the instructions if I didn't have it. Since I had it, I used it anyway for checking." When asked which instructional format he liked better, he answered, "I would recommend the video because you can see the actual mouse movement, for example, to click on a certain push button or menu

Student F spent 16.5 minutes on the post test. He explained how he created the forth slide without the instructions, "Now without the video I am going a little quicker. Basically when I use the computer I just do it; if I mess up, I can always go back." On trying new things and recovering from error, he said "There I picked the frog [an animation object] and made the frog box too small, but I know how to make a box bigger so I made the frog the size I want."

When Student F was asked to describe his own learning style, he answered, "I like it being hands-on, and being able to see what I am doing. I don't like just to 'sponge in' and dump it on paper

In a careful review of all the think-aloud interviews in which the learners answered open-ended questions to explain their learning performances while watching the video recording of their learning Astound, five learning patterns emerged: (1) following through error correction, (2) confirming actions, (3) hand on mouse, (4) keeping up step-by-step with the video instruction, and (5) trying new steps. Using analysis of patterns in time (APT), a methodology that can code event changes over time, the frequencies and the amounts of time of the five learning patterns were calculated. The data derived from the APT scores indicated two major findings: (1) The amount of time used by the participants ranged from 20 to 87 minutes. The amount of time spent did not predict mastery of the post test. (2) 'Following through error corrections', 'confirming actions', and 'trying new steps' were the patterns that did appear to predict mastery, and the other two patterns were indicators of learners' task engagement. The findings suggest that it is important to design flexible instruction to facilitate repeated, persistent, and successful practice in order to achieve mastery in a self-paced, computer-based learning environment, regardless of the amount of time spent.

Suggestions to Practitioners

First and foremost, the implications these dynamic learning patterns brought to the instructional designers and teachers are:

(1) Ideally, there should not be any time constraints in a self-paced computer-based learning environment. However, in classroom settings and even in corporate training settings, there are time limitations. As teachers and instructional designers, we should try to mitigate the way the timed classroom hour shapes learning. For example, in a traditional classroom hour, Student H, a master who took 87 minutes to finish the task, would have failed to master the task if she had had to stop after 50 minutes. We need to develop new ways of structuring the time of the class so that such failures would not be built into the classroom framework. Nevertheless, the immediate value of self-paced learning will be outside of the classroom where the learners or trainees can determine or have control over the time they use to learn the tasks.

(2) Those learners who have difficulty with following through error correction may have problems with a lack of lower-level computer skills. The present writer recommends that under such circumstances that the instructional designer needs to develop a mechanism to detect the problem quickly and refer the learner to simple optional lessons on the conventions of the operating system (e.g., Windows 95 in this study) and the basic features of the application software program (e.g., the tools featured in Astound in this study).

(3) If those learners who choose to use exclusively the text-only printed instructions and have difficulty finding the features, tools, push buttons, or have difficulty finding "where they are" from just a verbal description, then if space and format allow, the related graphical icons of the tools and the appropriate screen captures should be added to the printed instructions.

(4) Making the printed (verbal) and the video versions of the instructions as well as the computer with the software program available as options *at the same location* can accommodate most learners' preference in terms of forms of content and sensory modalities.

(5) For those learners who like to try new steps, the learning lessons should be flexible. However, for those who do not like to explore new things, more structured jumpstart lessons at the same or at different levels of complexity should be provided.

(6) Many participants in this study strongly suggested that more "context sensitive" hints or notes should be made available on both the printed and video instructions because the just-in-time hints or notes given immediately before or after the "problematic spots" helped some learners recover from errors quickly without getting frustrated. Therefore, it is important to observe where in the lesson learners tend to have problems with something, then design and position the "anticipatory fee

Discussion

In this study, there were five learner-demonstrated patterns identified in a self-paced environment in learning to take part in a computer software program. Although generalizations cannot be made for all people in all kinds of learning because of the relatively small and selected sample, the trends found in the data do suggest that a number of these learning patterns would be predictive of mastery in procedural learning. Future studies with a larger randomly-selected sample size will further test the character of these trends.

This present study used Kolb's Learning Style Inventory (LSI) as the screening tool to select samples because the LSI is a popular instrume
weaknesses as a learner" (Kolb, 1976) and used widely for career predictions. Comparing the activities from the emerging learning patterns identified in this study with Kolb's four learning abilities, we can draw some parallel relations between them: reading printed instructions is an example of abstract conceptualization (AC); watching a video demonstration, an example of reflective observation (RO); doing the steps as described in the instructions, an example of concrete experience (CE); and trying new steps, an example of active experimentation (AE).

Kolb's learning styles are generated from two combination scores (AC - CE and AE - RO) that indicate the extent to which an individual emphasizes abstractness over concreteness and action over reflection. However, the similarities between Kolb's learning styles and the identified learning patterns end here. One fundamental difference between these two is that Kolb assumes the learning styles are stable personality traits, whereas the learning patterns identified in this study are dynamic in nature. For example, while student F was designated as a converger with tendency to be abstract and active, according to Kolb, he actually demonstrated in his learning performance that he engaged in all four learning abilities over time. Student F was watching the video demonstration (reflection) and following each step as it was described on the video (concreteness). He also frequently checked with the printed instructions to see if he did the steps right (abstractness). After getting more familiar with the computer program, he started to try new steps that were not included in the instructions (action). Over all, Student F showed a dynamic learning sequence that involves several learning patterns that even he himself could not have predicted or repeated.

In the present study, the major finding is that regardless of the amount of time spent, repeated, persistent, and successful practice tends to lead to the mastery of the post test. This finding echoes the result found by Sze (1988) that repeated masteries during practice strongly affect student learning achievement and attitude in an adaptive computer-guided practice environment. Also, it concurs with the Academic Learning Time (ALT) research reported by Berliner (1979) that when students spend more time engaging in a particular curriculum content area, they are more likely to attain higher academic achievement. It is important to note that the above-mentioned findings strongly support Carroll's (1989) argument that aptitude is primarily a measure of time required to learn. This argument is in contrast with the classic models (based upon theories of intelligence) in which all learners are given the same amount of time to learn, and the focus is on differences in ability.

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Does the labeling of links assist user orientation?

Rolf Zajonc & Lutz Schön
Humboldt-University
Invalidenstr. 110
10115 Berlin, Germany
zajonc@physik.hu-berlin.de
www.physik.hu-berlin.de/ger/gruppen/didaktik/a06.htm

Abstract: Hypermedia learning material often makes broad use of links to information which goes beyond the learning objectives. But instead of being additionally motivated some students rather feel too much asked of. Within the Lilienthal project (www.pilotschool.net) links that don't follow the linear navigation are labeled with respect to their relevance for the learning objectives. First evaluations prove that the students welcome this assistance.

Introduction

"Information overflow" or "lost in hyperspace" are keywords, which also are frequently used to describe the difficulties of students using hypermedia for learning purposes. Indeed they give a good impression of what may hinder students from enjoying the new technical possibilities offered by the internet in contrast to their teachers expectations. When creating webpages instructors believe they can motivate their students by offering many links to further interesting or related aspects on the specific subject matter. But e.g. many lecturers report, that rather the opposite effect is shown by their students: learners tend to complain about the number of webpages they are supposed to visit (Dunlap 1999).

The problem faced is, that while the lecturer wants to offer the students the best chances to learn the subject matter as well as possible, the student also has in mind, that he needs to achieve certain learning objectives within a certain amount of time, e.g. to be prepared on time for an examination. Consequently students feel overwhelmed and frustrated by the amount of information, because they cannot differentiate between more and less important links as their teachers can. One possible solution to this problem might be the labeling of the links according to their relevance for the required learning objectives, e.g. by the use of small icons in front of links.

Labeling of links according to relevance

This directly leads to the first question: How to decide on the relevance of a link? The answer can be easy, if the creator of the webpages and the corresponding examination responsible are the same person. But in many cases the learning material is programmed by a team whose members can have different opinions on this question. As this also affects the pages' content in general, it is necessary, that the complete team agrees on a set of well formulated (e.g. Mager 1978) detailed learning objectives before the actual programming takes place. Afterwards the links can be labeled with respect to these detailed learning objectives.

In order not to confuse the students within Lilienthal it has been decided to restrict the labeling to three icons:

-***mandatory***, e.g. a link leading to a formula which the student must know by heart;

-***recommended***, e.g. a link leading to an interesting example which illustrates the effects of the formula in a certain context; or

-***nice to know***, e.g. a link leading to an abstract about how this formula had been discovered historically.

Of course it still remains the student's decision whether he follows a link and for how long he stays on the corresponding pages.

Research

Hypermedia material for roughly 80 hours of learning time has been distributed to pilot students of four European flightschools. The material had been programmed after a Delphi-process (Linstone & Turoff 1978) which lasted one year, during which several subject matter experts of all involved flightschools had discussed and finally agreed on a set of detailed learning objectives, each describing 5 minutes of learning time. On this basis, the links within the material have been labeled as described above. The number of links vary per module (9 DLO in average).

At this point in time (March 2000) evaluation of the various data (tests, questionnaires, protoquols) has just started. A first evaluation of 208 questionnaires on 11 different modules (average 45 minutes) not only proved that the big majority of students found the labeling of links useful (compare figure 1), but also that there is a strong correlation ($p < 0.01$) to the statement "the module is easy to operate". A reasonable interpretation of this correlation is that those students who made use of the additional info of the labeling icons, also felt they had a better control in general.

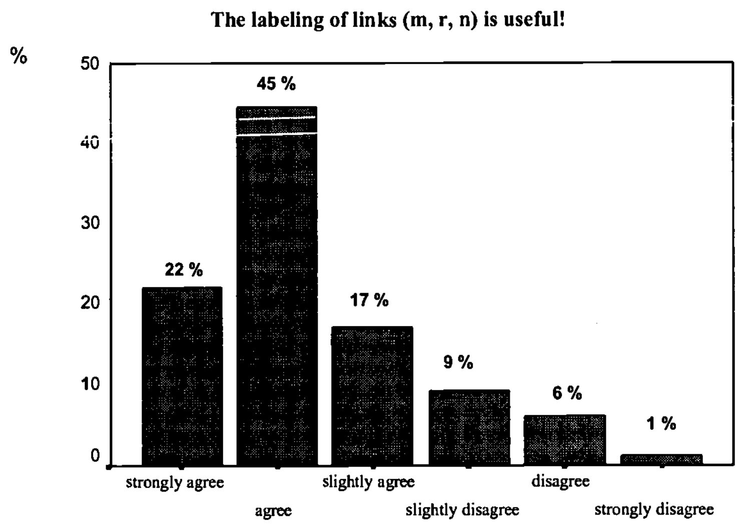

Figure 1: Evaluation of 208 student questionnaires on 11 different modules for the statement *The labeling of links is useful!*

Nevertheless further investigations are required, e.g. because in the pre-evaluation (in total 19 students) 14 out of all 17 students who marked "(strongly) agree" almost immediately added "...but still you click on every link anyway". This shows a well known behavior of hypermedia users, who only have little navigation experience. The assumption is, that the labeling will have a stronger influence on the 'click or no click'-decision in the long run.

In this context, although in our case the pilot students certainly form a rather homogenous group (typically male, age 19-23, open-minded for technically related matters, good marks in physics and mathematics), it is still expected, that students are influenced differently by this labeling. E.g.

A students still click on every link,

B students select recommended and in particular nice-to-know links according to the indicated topics,

C students avoid most recommended and all nice-to-know links.

In addition it might well be possible, that a student changes his attitude in the courses process. As has been mentioned before, in particular novices might rather show A behavior, but after a while they are expected to realize, that they need to work more efficiently and become B or C students.

But the labeling should not only influence the decision whether to click but also the navigation on the following pages. A student should be more likely to really *explore* a webpage if he knows its content belongs to the mandatory level. In contrast he might show *scanning* navigation (Canter, Rivers et al, 1985) if he knows that he needn't follow the link before at all. Since so far almost no experiences are reported in this context, these are just reasonable assumptions, which need to be investigated.

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SHORT PAPERS (Work in Progress)

When is an Interactive Learning Scenario a Matter of Interface Design?

Christian M. Adriano, Adriane M. Adriano, Ivan L. M. Ricarte
State University of Campinas, Brazil

Interaction is an important feature a learning activity must promote. Parker (1999) outlines benefits provided by interaction: "Understanding and long-term internalization can only be acquired by communication, reconstruction and reconciliation of information; interaction enables socialization, promotes motivation, and learning commitment; interactive processes foster comprehension and consensus on universal truths".

In previous research (Adriano et al.1999), we implemented a computer supported learning scenario by producing content, modeling evaluation, and choosing a proper pedagogical orientation. Our effort resulted in the first version of the CALM platform, which implements a learning scenario inspired by the Goal Based Scenario approach, provides an intelligent tutor, and hosts material for learning Java. In order to guide further effort on interaction, the following problem was posed: When is an interactive learning scenario a matter of interface design? We propose two situations in which developing interactive learning scenarios incurs in interface design. First, when concern fits on one of the items proposed by Marcus (1994): Mental and Navigation Models, Appearance, Interaction, or Metaphor. Second, when the learning scenario, implemented by the resulting interface design, must accomplish complementary definitions for the concept of "interaction".

Metaphors are fundamental concepts communicated through words, images, and sound. Mental models are data structures, functions, tasks, roles, jobs, and people in organizations of work. Navigation is the process of moving through the mental models. Interaction is all input-output sequences and means for conveying feedback. Appearance relates to visual, verbal and acoustic information.

The designed metaphors (Adriano et al. 2000) were annotation, document, and annotation-place. The design of the interaction item resulted in three annotating paradigms represented by specific annotation-places: Bridge, Inline, and Tree. The Bridge place represents the idea of annotating as adding links. The Inline place supports the paradigm of writing over the text and having the annotation content visible. The Tree place organizes annotations in a newsgroup-like fashion. The mental model comprises the annotation-place model and organization of roles. In the former, a document may contain many annotation-places and an annotation-place may contain many annotations. The organization of roles depends on each learning scenario specification. The navigation model comprises resources to manipulate metaphors. Such resources correspond to: annotation editing interfaces, a search tool, a document composition tool (annotation-places are implemented as applets within Web pages), a tool for repositioning annotation-places due to changes in the original Web page, and a tool to generate workbook-like compilation of annotations. The appearance item relates to types of annotations and annotation-places. The annotation metaphor has four visually different types: doubt, suggestion, commentary and mark.

The discussion scenario comprises theme presentation, individual annotation, group annotation, and discussion summarization. Roles are "moderator" and "commenter". The theme presentation is a notification that the Web page hosting the text for discussion is available for commenting. After notification, starts the individual annotation phase in which commenters read and make personal annotations on the text. In the next phase commenters may request the annotations of their peers and discuss opinions and acknowledgements, which involves commenting on each other annotations. When discussion is finished, due to a deadline or a common agreement, the moderator compiles annotations into a second text elaborating a summary of the discussion.

The co-authoring scenario includes goal definition, authoring, reviewing, voting, and consolidation. Roles are "co-author", "reviewer", and "author". Co-authors annotate using inline annotation-places and may define when an annotation is ready to be seen by others. Reviewers may comment on annotations made by co-authors. As a co-author decides that an annotation should become part of the underlying text, he/she requires the author to consolidate the annotation. If the author agrees, the annotation is incorporated to the text. The author can also ask for co-authors to vote whether an annotation should be consolidated. An annotation has states such as ready, removed, in consolidation, being voted, and not available.

Some interaction definitions were collected from Vigotsky, Habermas, de Certeau, and Chartier. Vigotsky (1978) deals with the cultural dimension of learning. Apprenticeship is result of interactions among historical subjects and the world. Signs and symbols are the condition for these interactions. People, instruments and signs mediate relations between a subject and physical/social environment. Signs correspond to a representation of reality and refer to remote times and spaces. Interaction is conceptualized as relations among historical individuals, signs, and instruments. Such definition is satisfied by interfaces that relate individuals as role players, signs as metaphor representations and instruments as tools of the navigation model.

Certeau (1974) states that interaction is based on a metaphor of landmark and on distinctions between place and space. In short, place is static and permanent, while space is dynamic and transient. Landmarks delimit regions (spaces or places), being also classified as dynamic or static. Static landmarks are frontiers, like rivers and fences, delimitating places. Dynamic landmarks are bridges, like doors and windows, delimitating spaces. Bridge-like landmarks represent encounters of action. Moreover, there will be so many bridges as the number of "interactions". Interaction is defined as a bridge separating spaces of action. Such concern inspired the design of annotation-places, whose types provide different bridging between the document space and the annotation space.

As quoted by Prestes (1997), Habermas argues that the communicative action has a kind of anchor constituting background knowledge. Such knowledge fosters interpretations for participants of an interaction. The background knowledge relates to a world of life (*Lebenswelt*), the horizon on which we move. It is pre-scientific, intuitive, not expressed and not questionable. It constitutes itself not only by cultural convictions, but also by institutional organizations and structures of personality. Habermas uses the daily communicative praxis to guarantee the symbolic reproduction of three spheres; culture, society, and personality. Culture refers to knowledge acervus, over which we formulate interpretations to understand the world. Society refers to legitimated organizations that regulate our bindings with social groups. Personality refers to competencies that enable subjects, capable of language and action, to take part in an understanding process. The following citation of Habermas clarifies these three aspects: "In respect to the functional aspect of understanding, the communicative action promotes tradition and cultural renovation. In respect to coordination aspects, the communicative action promotes social integration and creation of solidarity. In respect to socialization, the communicative action promotes formation of individual identities". Interaction is a space of conflict between a pre-comprehension of world of life and the communicative action. Therefore, when and where interaction happens, the stability of the world of life is disturbed by arguments of the communicative action. Annotation interfaces enabling discussion was a mean to accomplish such vision.

Following a historical point-of-view, Chartier (1997) provides a study of how mankind has been interacting with and by means of the written letter. Medium has changed from papyrus, to codex, to Gutenberg press, and, nowadays, to digital text. Each medium required a proper interaction paradigm suggesting that interaction be also defined by the enabling technological support. In other words, medium defines interaction. Such concept for interaction was accomplished by supporting audio and written media for annotation.

In addition to the five components proposed in Marcus (1994), we suggest a careful study of the interaction concept. The presented discussion stems from project meetings between educators and software developers. A recurring problem faced was the lack of consensus on concepts, accompanied by concerns of presupposing things that needed better understanding before implementation. Interaction conceptualization is one these concerns. We hope the ongoing research will collect further insights to the design of interactive learning scenarios as a cooperative entrepreneurship of educational and computer scientists.

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An Interactive System Model of an Online System for Teaching & Learning Developed as a Scoping / Costing Instrument

Anne A'Herran, Educational Development Adviser (WWW), Teaching and Learning Development,
James Cook University, North Queensland 4811, Australia.
anne.aherran@jcu.edu.au

Abstract

Although there are strong reasons for purchase of an off-the-shelf system for online course delivery (including the competitive advantages of reliability, the comfort of a large client base and scalability), many universities develop a system themselves. These home-grown systems are often more responsive to specific needs. When James Cook University undertook to investigate available systems for university wide online course delivery it was important to explore costs of building a system using university resources. To this end a system model was designed as an interactive diagram reflecting each part of the system in prototype http://www.tsd.jcu.edu.au/jcudevelop/jcuproto/jcuonline The model is both an innovative example of organisational design method and a useful means of testing user pathways through the system, (use-case), which can assist costing and project management of the development of such a system.

As part of the search for the most suitable system for use at JCU we set out to determine the costs of building a system using university resources:

- there was a high level of interest in the JCU community;
- the possibility of economies of production;
- a collaborative venture of this kind with the potential for cross-institution partnerships could be of value to the university in the future.

To this end a system model was designed as an interactive diagram reflecting each part of the system, in prototype (at http://www.tsd.jcu.edu.au/jcudevelop/jcuproto/jcuonline).

The model is both an innovative example of organisational design method and a useful means of testing user pathways through the system, (use-case), which can assist costing and project management of the development of such a system.

Discussions were held with the schools of IT and Computing Science. The interactive system model was felt to be helpful in this process in that it provided, by visible and testable means, a common understanding of the scope and direction of the exercise. Costing was based in staged development from base level, adding functionality as we saw a need.

There was found to be no case for developing DIY for immediate implementation:

- the real costs of DIY infrastructure are high for a one-off development which is not amortised over other products;
- time of development has to be compressed to keep pace with user needs and technical innovation: to compress time requires commitment of personnel which increases costs;
- when a university implements its own system, support for users becomes an internal budget decision not externally (market) driven: support is therefore subject to internal budgetary pressures rather than the wider driving client base.

Validating a Theory-Based Design for Online Instruction: Aligning Tool Use and Learning Outcomes

Arshad Ahmad
McGill University
1455 DeMaisonneuve
Montreal, Quebec. H3G 1M8
arshad@mercato.concordia.ca

Abstract: This paper provides a theoretical framework for the design of a successful web-based course in Personal Finance. Using an open learning model based on constructivist principles that draw from the literature in cognition and the social sciences, this paper sketches an instructional design model and specifies online tools that mediate between course objectives and desired learning outcomes. In order to validate the model, data generated from tool use and from student performance will be analyzed using confirmatory factor analysis.

Mixed Messages with Multimedia

A growing body of research is exploring the learning effects of multimedia designed environments. Some of this research has attempted to incorporate educational concepts in the design, process and implementation of course production in technology-rich platforms. However, the results are mixed. According to *The No Significant Difference Phenomenon* (Russell, 1999) which is based on 355 research reports, summaries and papers, the conclusions mainly indicate that the learning outcomes of students using technology enriched courseware are similar to those of students who participate in conventional classroom instruction. Yet, universities are allocating substantial resources towards the development of distance education courses and programs (Brahler, Peterson et al., 1999) to increase access to learning, with the hope that the quality of education will be damaged little, if at all (Ehrmann, 1999) Questions and concerns relating to technology integration are being raised, but as yet have had little systematic impact on the policies that guide educators, administrators and practitioners (Merisotis and Phipps, 1999; Welte, 1997)). Faculty realize that there are certain benefits of technology-based distributed learning environments, but put up considerable resistance to the development of such environments (Rickard, 1999).

Mixing Cognitive and Social Science Approaches

This working paper presents a theory-based design of an undergraduate web-based course in Personal Finance with the aim of addressing some of the issues addressed above in the context of better understanding student learning. Concerns relating to technology integration in educational practice, and technology's intersection with learning theory are addressed in a design framework that aligns learning objectives, course activities and assessment methods. This alignment simultaneously considers the selection of online learning tools that mediate between design components for Personal Finance. The selection of learning tools also plays an important role in terms of how they will be meaningfully used by students, and how they will affect student performance.

Web-based instruction that is designed on accepted theoretical principles in cognitive psychology opens new doors to designers, learners and practitioners. This is simply because we know very little about best practices arising from the design of courseware that primarily uses this medium. However, in contrast, there is an abundance of theoretical studies in the cognition literature that have increased our understanding of competence in understanding a given discipline (See for example, Anderson, Corbett et al., 1995; Ausubel, 1968; Hatano, 1996; Means, 1993; VanLehn, 1996; and Winn, 1990). Similarly, studies from the literature in social sciences have proposed interactive socio-cultural contexts as a basis for understanding how learning can be constructed, scaffolded and facilitated (See for example, Bandura, 1986; Brown, Collins et al., 1989; Derry and Lesgold, 1996; Lave and Wenger, 1991; Moore, 1994; Shuell, 1993; and Richey, 1994. In his 1999 AERA Presidential Address, Alan Schoenfeld describes the split between cognitive and social science research with references to studies in cognition that excel in fine-grained data analysis but suffer from tunnel vision and points to as many sociological studies that are rich in scope but are weak with respect to validity and reliability constructs. His suggestion to bridge the gap was to "build something to see if it works and then study the hell out of it".

This study seeks to validate a non-traditional design based on theoretical findings from the cognitive and social sciences literature. The world-wide-web is an obvious choice as the platform for building a design prototype because learners recognize that it is more accessible and convenient than traditional opportunities afforded in the classroom. Combining the web platform and a theoretical basis into a prototype design becomes meaningful when specific learning goals arc specified with evidence to link these goals with performance outcomes that are assessed. These links are critically explored and are the focus of this study.

Challenges in the Design Process

The term technology is used broadly to refer not only to tools but also processes and is closely identified with the Greek form *techne* (art, craft, or skill), which was closely associated with *episteme* (systematic or scientific knowledge). Its educational meaning is historically derived, bound by specific psychological theories and philosophical underpinnings (Saettler, 1990). Visions of technology look very different depending on the explicit theories of learning that guide their design and implementation. According to The Cognition and Technology Group at Vanderbilt (1996), the challenge for instructional design based on significant technology integration is that learning theory, educational practice and technology interact with each other. To understand the role of technology, one must examine a simultaneous intersection with student learning and educational practice. This challenge is increased since all three areas have seen dramatic change in the past ten years. Thus, changes in theories of learning affect uses of technology, but new technologies such as the world wide web also make new kinds of interactions possible and hence affect theories of learning (Kozma, 1994; Saloman, 1993). Knowledge acquisition in constructivist environments engages learners in drawing meaning from multiple perspectives and through collaborative efforts. Engagement in real world or authentic tasks provides a context for the learner to construct meaning from his/her experiences. Thus, learning is situated in a community of learners who construct personal meaning through dialogue and socialization (See Brown, Collins et al., 1989; Jonassen, 1998; & Wilson, 1995).

Sketching the Design Components

Given these perspectives, different views of how humans learn and how designers approach instruction are incorporated under the umbrella of knowledge acquisition and knowledge construction. In addition, aspects of situated cognition, which emphasizes social and ecological interactions is also included. Parts of the design relies on an information processing view emphasizing course content that hierarchically structures the sequence of information. Using Hannafin, Land et al.'s (1999) open learning model which emphasizes diversity and choice, course material was selected to reflect a variety of print-based, multimedia and interactive web-based tools that could best enable the learner to attain the learning goals set for the course. The importance of constructive alignment between different design components is emphasised by Biggs (1999); they become inextricably linked, so that the course becomes greater than the sum of its parts. These components include a *textbook*, *short vignettes* with practionners who introduce each topic, *simulations* that forecast your net worth, or your tax bill, *interactive practice tests* including pre-tests, review exercises, short cases, etc and *communication software* that allows for threaded discussion, chats, critiquing, posting and other activities consistent with best practices in effective learning communities. Technology has been nested within a constructivist framework to raise the intellectual, social and ethical standards of learners, by empowering them to question, participate, and practice authentic issues in personal finance. Jonassen, Davidson et al. (1995) summarize this approach:"...learning is necessarily a social dialogical process in which the communities of practitioners socially negotiate the meaning of phenomena" (p.9).In addition, feedback opportunities are provided by experts (the instructor as well as practionners) to ensure accurate knowledge acquisition. Finally, communication strategies are designed to facilitate elaboration of content and solicitation of responses that reflect what students are thinking. Here, the tools employed include interactive tests, e-mail and bulletin boards, as well as audio conferencing.

Data reflecting student use of designed tools and their performance on assigned tasks will be collected to confirm the validity of the design model. Evidence of learning using Bloom's (1956) taxonomy will reveal the general factors associated with the model. Path analysis will be used to confirm the relationship amongst the design components as they fit within the instructional design model.

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Learning Strategies for Multi-Media Instruction

Mohamed Ally, Ph.D.
Athabasca University
1 University Drive
Athabasca, Alberta,
Canada, T9S 3A3
mohamcda@athabascau.ca

Abstract: Multimedia instruction must follow instructional design principles that are based on learning theories. This session will share an effective model for designing learning materials and will describe the strategies that should be used when designing multi-media learning materials.

Pre-instructional Activities

Before teaching new materials to students, the lesson must overview the materials so that students can form a mental set for the materials and become motivated to learn the materials. The different types of pre-instructional activities include content map, advance organizer, pre-test, learning objectives, and rationale.

Prepare Learning Activities

Conventional instructional methods tend to use passive instructional strategies. It is important to use strategies that will keep students active so that they will be motivated and will process the information in greater depth. To encourage active learning, it is important to use discovery strategies so that students can find out things for themselves. Instead of teaching a large amount of information to students, we should give students the task and then guide them to find and apply the information. Multi-media and on-line instruction are excellent methods to promote active learning.

Elaborative Strategies

To make the instructional process more effective and efficient, the lesson must provide activities for students to process the content at a deep level. The deeper the information is processed, the better it is learned or remembered. As a result, the instruction should contain elaborative strategies to help facilitate deep processing. Some common elaborative strategies are asking questions during the instruction, ask students to summarize segments of the instruction, requesting students to make their own notes, and asking students to underline or highlight important information. The elaboration process facilitates efficient storage in long-term memory. This is important since the ease of retrieval will depend on the way the information is stored in long-term memory.

It is known that when new learning materials are encountered, they are attended to and transfer to short-term memory storage. After entry into short-term memory, the information must be transferred to long-term memory immediately since short-term memory has limited capacity. As a result, students should be given the opportunity to elaborate on small segments of instruction so that the materials can be transferred to long-term memory immediately.

Presentation Strategies

Most instruction is done in an expository fashion where the learning material is presented in its final form to students. The most common expository methods are rote, inductive, and deductive learning.

The rote method consists of presenting the materials to students and then asking them to recall the materials as presented. For example, the lesson may present a rule and then ask students to recall it. The deductive method occurs when students are given a rule followed by examples to explain the rule. The inductive method involves giving examples on a certain rule followed by the rule. However, to make learning more efficient and effective, discovery strategies must be used. With the introduction of new instructional technologies and multi-media, it is possible to design instruction that contains discovery strategies.

Practice Exercises

Another important component of instruction is practice with feedback. After the presentation of the materials, students should be given the opportunity to practice what they have learned so that they can get feedback on how they are performing and at the same time prepare them for the final test in the lesson. In addition, the practice test acts as a good learning strategy since test questions usually consist of general ideas which act as cues to recall specific details and skills.

Summarize the Lesson

After the lesson is presented to students, they should be given a summary so that they can get a sense of closure for the lesson and gives a general review of the lesson.

Web-Based: Instructional Effectiveness

Nella B. Anderson
Western State College of Colorado
112 Kelley Hall
Gunnison, CO 81231
nanderson@western.edu

Abstract: Training preservice education students on the Internet requires the course to be more structured than would be required to teach the same course without an electronic component (Gillette, 1996). Education students have consistently expressed the need to see technology used by their university instructors if they are to use these tools effectively in their own teaching (Larson & Clift, 1996). Due to both a lack of suitable instruments and the importance of being able to assess web-course effectiveness, the authors developed the Web-Based Survey of Instructional Effectiveness (WebSIE) to meet this need. Forty-one students enrolled in a web-based course were given the WeBSIE prior to and after the completion of the course. Pretest to posttest comparisons showed students improved in their self-reported web-based skills and attitudes in the use of the internet, integration of the internet into instruction, general computer use/attitude and using a computer for communication. Future studies need to replicate these findings and investigate the effects of the integration of technology into more and varied teacher training courses.

The effective use of technology includes rethinking traditional forms of instruction. Instructors teaching online need to maintain the perspective that we learn best "with" technology rather than "from" it (Johnson, 1996). This perspective allows instructors to engage students in active (Copley, 1992; Reeves, 1996; Yakimovicz & Murphy, 1995), authentic (Copley, 1992), challenging tasks (Copley, 1992; Reeves, 1996), and collaborative efforts (Reeves, 1996; Yakimovicz & Murphy, 1995).

A computer-specific introductory course is usually insufficient in modeling for preservice teachers the use of technology as a tool for teaching and learning (Topp et al., 1994). Education professors from various disciplines must begin to use technology as a cognitive tool to mediate and transform the training experiences of teacher education students (Larson & Clift, 1996).

Instructional Design

Training preservice education students on the Internet requires the course to be more structured than would be required to teach the same course without an electronic component (Gillette, 1996). The structure that is embedded and remains consistent throughout each unit of study. The structure of an introductory special education course taught online will be elaborated on in this section by clustering the components into categories and providing a brief description of each.

1. Instructional Design Framework
   (a) Each unit of study is divided into six instructional steps.
   (b) Each of the six steps are divided into instructional components.
   (c) Reference numbers are assigned to each of the instructional components. The reference numbers are depicted using three digits separated by decimals (e.g., 2.3.4 represents Unit 2.Step3.Activity4). The reference numbers are used when discussing activities via e-mail, newsgroup, and/or chat.
   (d) Buttons are located at the bottom of each of the six instructional step pages so that students can go to the "next step" or return to the "unit index", which provides links to all six steps.
2. Curriculum Development
   (a) The curriculum is built upon the principles of active learning, cooperative groups, peer-mediated instruction, and content experts

(i) Active learning is integrated into the course through the use of interactive forms and case studies found on the Internet.

(ii) The class is divided into cooperative groups of two based on where students live and their educational major.

(iii) Peer-mediated instruction is used through the creation of student homepages and peer expertise pages. These pages allow students to share their work and ideas with each other.

(iv) Content experts are utilized by incorporating parents of students with disabilities and personnel in special education field in local public schools into the class discussions (e.g., e-mail, chat, and newsgroup).

(b) All activities taught in the traditional course on campus are incorporated into this online course through the use of e-mail, chat, newsgroup, electronic handouts, forms, and web sites.

Teaching in this virtual classroom in comparison with teaching in the traditional classroom requires much more learning and much less teaching (Peterson & Facemyer, 1996). The dynamic learning environment available online, which is expanding at exponential rates, provides opportunities for students to become explorers and discoverers (Gates, 1996).

Education students have consistently expressed the need to see technology used by their university instructors if they are to use these tools effectively in their own teaching (Larson & Clift, 1996). All students enrolled in this online course had completed at least one required computer-specific course prior to the beginning of this online course. The development of a survey of instructional effectiveness was developed by the authors to measure the effects of learning educational content through the use of web-based technology.

Web-Based Survey of Instructional Effectiveness

Due to both a lack of suitable instruments and the importance of being able to assess web-course effectiveness, the authors developed the Web-Based Survey of Instructional Effectiveness (WebSIE) to meet this need. Expert opinion from individuals with both academic credentials (Ed.D. or Ph.D.) and web-based course experience were sought to develop an original pool of 58 items. This pool of items was subjected to factor analysis. A five-factor model was adopted retaining 30 items: Use of the Internet (8 items); Integration of the Internet into Instruction (8 items); General Computer Use/Attitude (4 items); Using a Computer for Communication (5 items); and web-based Course Effectiveness (5 items).

Using this 30 item survey authors administered 313 to preservice education students and practicing teachers. Cronbach's alpha and split-half reliabilities were calculated for the five scales. Alpha for the whole 30 item instrument was .803, and the five scales were Use = .557; Instruction = .531; Computer Use/Attitude = .415; Communication = .653; and Course Effectiveness = .419. Split-half reliabilities for the five scales were Use = .762; Instruction = .750; Computer Use/Attitude = .726; Communication = .823; and Course Effectiveness = .672.

Forty-one students enrolled in a web-based course were given the WeBSIE prior to and after the completion of the course. Single-sample Dependent T-tests were performed on all five scales. An alpha level of .05 was used for all statistical tests. Four of the five scales were significant: Use, $t_{41} = 4.873$, $p < .001$; Instruction, $t_{41} = 4.143$, $p < .001$; Computer Use/Attitude, $t_{41} = 3.797$, $p < .001$; and Communication, $t_{41} = 2.401$, $p < .02$.

Pretest to posttest comparisons showed students improved in their self-reported web-based skills and attitudes in the use of the internet, integration of the internet into instruction, general computer use/attitude and using a computer for communication. These statistically significant gains in web-based skills and attitudes were noted after one education methods course that modeled the use of the Internet in instruction. Future studies need to replicate these findings and investigate the effects of the integration of technology into more and varied teacher training courses. Additional effects of the integration of technology into teacher training programs needs be studied after these preservice teachers become practicing teachers, focusing on how often and in what ways they integrate technology into their own teaching.

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The Interaction and Psychological Distance in Educational Situations: Experimental View

Shaker Hasan Aradi
Institute of Education, University of Tsukuba, Japan
shaker@human.tsukuba.ac.jp

Abstract: This paper reports the findings of a study conducted with an experimental undergraduate-level class. It investigated the differences between learners studying with the teacher face-to-face and learners studying at distance in terms of three dimensions; ① learners' sense of distance, ② interaction, and ③ achievement.

Introduction

One of the most important innovations resulting from the remarkable advances in communication and Internet technologies is *'face-to-face at distance education'*, which is forcing us to adapt new definitions, theories and practices. Physical distance is no longer the limiting factor; *"psychological distance"* is. Drawing on Moore's work redefining "distance", "interaction" and "transactional distance" (Sewart, 1988 & Moore 1991), the concept of psychological distance (PSD) refers to how close the participants within the educational environment feel to each other in terms of emotional comfort and satisfaction.

As Holmberg (1988) observes "real learning is primarily an individual activity and attained through an internalization process;" thus, learning is the product of internal interaction between the learner's previous experiences and new information obtained from external interaction with the other components of the educational situation, including contents/media, other learners and the teacher/instructor/coach.

The present study focuses on this interaction within the educational environment, in terms of the *learners' sense of distance*" (SoD)[1], as a direct indicator of PSD. Specifically, the main objective of the experiment is to examine the relationships that exist between: a) "the learner's sense of distance", b) "interaction within the educational environment" and c) "learners' achievement".

The Study

Twenty-two (only the data from 19 participants was usable) Japanese undergraduate-student volunteers, from a women's university attended four seminars entitled "Introduction to Public Speaking" during spring, 2000. The participants were divided into two equal groups, matched for age and scores for English and Japanese language; a "*local group*" (LG), which studied with the teacher face-to-face and a "*distant group*" (DG), which studied with the same teacher at distance. An ISDN-based TV conferencing system was used to mediate communication between the two groups, so that they can study in different places at the same time. Achievement was evaluated by pre-tests and post-tests. The participants were asked to evaluate their "sense of distance" from others (i.e., the teacher, other learners in the same group and other learners in the other group) on a 5-point scale, with 1 indicating very close and 5 very far. The participants also recorded both how often they actually interacted with others, and how often they wanted to, as an indication of the interaction within the educational environment. The classes, as well as short interviews after each class to regarding technical aspects such as sound and picture quality, were also videotaped for further analysis and to improve the seminar contents.

[1] Sense of distance is contrasted with "real distance," as a measure of the distance learners feel to exist between themselves and other components of the educational setting, irrespective of the actual distance.

Findings

The differences between pre-test scores concerning the participant's knowledge of public speaking for the two groups were not significant (average scores were 4.5 and 5.22 for the LG and DG conditions respectively). The scores for the post-test were 16.4 for the LG and 18.66 for the DG, indicating significant improvements in knowledge concerning public speaking for both groups ($p < 0.0001$). The average scores for both groups also indicate that there were no significant differences between the two groups in terms of achievement at the end of the experiment.

In terms of learners' SoD to the teacher, the average evaluation rating for the LG condition fell from 3.166 after the first class to 1.7 after the last class. In the DG condition, this fell from 4.7 to 3.00. Although analyses (Wilcoxon Signed Ranks tests) indicated that these changes were significant ($p < 0.025$ and 0.015 for LG and DG respectively), further analyses (Mann-Whitney U test) also indicated that there were significant differences between the two groups after both the first and last classes. In other words, although the learners' sense of distance to their teacher declined significantly for both groups, those in the LG condition felt much closer to the teacher then those in the DG. Reviewing the videos for both sites, we found that although the teacher almost had the same amount of interaction with both groups during the class, he did spend more time talking and explaining to the LG both before and after the classes, and that he was able to give more individualized attention to the learners in the LG condition, which may have contributed in making them feel closer to him.

The data indicated no significant changes in the learners' sense of distance to other learners in the same groups at both sites, which might be due to the fact that the students came from the same university. Examining the learners' sense of distance to the learners in the other group, the evaluation rating fell from 4.62 after the first class to 3.00 after the last class for the DG condition (significant at 4.6% level). However, there were no significant changes in the SoD for learners in the LG condition. This might be due to the initial setting at the LG site, which did not allow learners at the DG site to see their counterparts at the LG site during the first class, which was adjusted for later classes.

The correlation between the learners' SoD to their teacher and the records of interactions was –0.287 (sig. at the .05 level). Although no significant correlation was found between the learners' SoD to their teacher and achievement, the learners' SoD was highly correlated (0.636 sign. at the .01 level) to how important the learners regarded the contents, and how much they felt they had learnt (0.496 sign. at .1 level).

Conclusions

The results of this study suggest that it might be very difficult to acquire the same quality of interaction with physically-distant learners, and that it, therefore, takes more effort in order to reduce their SoD compared to learners studying face-to-face. Despite this, however, the more learners interact with their teachers the closer they feel to them regardless actual physical distances. Moreover, as learners feel closer to their teachers, they tend to regard the study as more important and to feel that they understand it.

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A Generic Pedagogical Agent Architecture That Supports Conversational Authoring

Jeremy W. Baer and Steven L. Tanimoto
Department of Computer Science and Engineering
University of Washington
Box 352350, Seattle, WA 98195-2350
jbaer@cs.washington.edu, tanimoto@cs.washington.edu

Abstract: Pedagogical agents offer great promise to improve the learning experience of students interacting with educational software systems. This paper describes work in progress on a generic pedagogical agent architecture and an authoring system to support the creation of custom agents by teachers and other domain experts using a natural, conversational metaphor.

The field of pedagogical agents is a recently emergent one which draws from previous work done in intelligent tutoring systems, autonomous agents, and educational theory (Johnson et al. 2000). Pedagogical agents have the potential to offer a wide spectrum of educational interactions with students, including opportunistic instruction, and have been shown to have positive affective as well as cognitive influences on students (Lester et al. 1997).

Several successful pedagogical agents have been designed for a variety of learning environments, ranging from skill-based training systems to more open-ended constructionist environments (Johnson et al. 2000). Currently, however, the task of building pedagogical agents is a non-trivial one which falls within the domains of researchers and professional programmers -- not those of teachers, curriculum designers, and other non-programmers. Authoring tools designed for non-programmers to create customized content for particular agents are under way, but little attention has been devoted to the question of authoring tools for creating customized agents, given a particular computer-based learning environment. It is to this question that we turn our attention in this paper. We will describe work in progress on a project which aims to allow teachers and other non-programmers to author customized pedagogical agents for interactive learning environments. We first discuss the design of a generic pedagogical agent architecture, suitable for use in constructionist learning environments. Secondly we discuss techniques we are developing to allow teachers to author agents based upon this architecture. We require that the architecture be suitable for constructionist learning environments due to their open-ended nature, which raises a greater challenge for the agent designer.

Our generic agent architecture (see figure at http://www.cs.washington.edu/homes/jbaer/pedagent/agentarch.jpg) is built around the Agent Control Module. This module is responsible for processing events received from the learning environment, updating its student and session models based on those events, initiating interactions with the student, and potentially sending commands back to the learning environment. The appearance and user interface aspects of the agent have been separated out into a distinct module. This allows for maximum flexibility in the appearance of the agent. Either the agent can appear in its own window, or the learning environment itself can implement this module, allowing the agent to appear within the main window of the environment, as do many of the existing pedagogical agents described by Johnson and Lester (Johnson et al. 2000) do.

The interaction between the agent and the learning environment consists of the agent receiving events from the environment and requesting state information from the environment or sending commands to the environment. It is up to the environment to define the set of events that will be sent to the agent, as well as the state and control commands that it wishes to expose. A distinguishing feature of this agent model is that we do not require the agent to have complete access to the state of the learning environment. While this can limit the information which the agent has to work with, it allows for interoperation with a wider variety of learning environments, all of which may represent their state in different ways.

While the Agent Control Module is the center of operations for the agent, it does not contain any built-in intelligence pertaining to any specific learning environment. Instead, it relies on the Agent Behavioral Control Description (ABCD) for this information. The ABCD is divided into four types of objects: potential student actions, agent interventions, pedagogical goals, and student concepts. Potential student actions are actions or classes of actions which the student might take within the environment, and which the agent should recognize. These actions are comprised of a series of events, each of which may contain a parameter sent from the learning environment to the agent. The sequence of events and their parameters can be generalized using regular expressions. Agent interventions may be of three distinct types - information presentation using text and images, agent-initiated dialog with the student, or agent-initiated intervention of arbitrary complexity by loading and executing an externally authored program. Pedagogical goals represent general learning objectives, for example, what the most important concepts are for a student to learn, what interaction styles to prefer, etc. Student concepts represent correct or incorrect conceptions that students may hold. Our notion of student modeling is based upon the work of Minstrell et al on educational facets (Minstrell 1992), and our student concept database is a facet base, in their terminology. The student model the agent constructs consists of a collection of student concepts; the agent infers these, and each is weighted with a confidence factor.

Since it is the Agent Behavioral Control Description (ABCD) which makes a particular agent unique, we must allow non-programmers to author it. Its rules are similar to rules in a declarative programming language. However, we do not want to require teachers to think like programmers. Our solution is to have the agent guide the author through the process in a natural, conversational manner. The agent directs the authoring process by asking a series of questions. As the author responds to these questions, the agent modifies the conversational flow and builds components of its ABCD, based on the author's input. In addition to direct question and answer, the agent utilizes generalization techniques from machine learning to allow for authoring by demonstration in some circumstances.

This authoring technique, which we call "conversational authoring", bears a resemblance to the command "wizards" which are found in a variety of applications. However, there are a number of factors that distinguish this authoring paradigm from application command wizards. One factor is that the interaction between the author and the system may be long-lived and span multiple authoring sessions. Because of this, a need exists for the agent to maintain continuity between sessions by being able to summarize the previous session and describe its current state to the author in a conversational manner. This self-description is also important for purposes of agent validation. The conversational authoring tool runs concurrently with the agent and learning environment, so the author can test the behavior of the agent at any point in the authoring process by using the environment from the perspective of a student. However, simply testing the agent may not provide enough validation that the desired ABCD structure has been created. The ability of the agent to conversationally summarize its state at any given point in the authoring process adds another tool that the author can use to validate the authoring outcome.

The work described in this paper is currently in progress. The generic agent architecture has been implemented in Java and integrated into a constructionist learning environment called PixelMath. PixelMath is a recent outgrowth of research at the University of Washington designed to teach mathematical concepts through digital image processing. Additionally, a custom agent has been built on top of the generic architecture by hard coding the ABCD in Java. We are currently in the process of implementing the conversational authoring tool, which will be tested for effectiveness by teachers familiar with the classroom use of tools like PixelMath. A complete description of this project, including current status, is available at http://www.cs.washington.edu/homes/jbaer/pedagent/index.html.

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From "Learning-by-Viewing" to "Learning-by-Doing": A Video Annotation Educational Technology Tool

Ofer Bergman, Ruth Beyth-Marom, Ahuva Leopold, The Open University of Israel
Doron Hadar, Ben Gurion University, Israel
Amnon Dekel, Interdisciplinary Center, Herzliya, Israel
Synopsus@netvision.net.il

Abstract: Video films are particularly suitable as a way of experiencing the world because they provide a dynamic, although vicarious, encounter through sound and vision. However, the use of video films in their present, mostly passive, form, do not succeed in contributing enough to the learning process. SYNOPSUS was designed to cause a shift from the passive "learning-by-viewing" model to the "learning-by-doing" model while studying with educational films. By utilizing a simple user-friendly interface, the tool allows students to engage, on a computer, in active, reflective, and interactive learning with existing video films. The tool and some preliminary results of an evaluation study will be presented.

Introduction

Video films are particularly suitable as a way of experiencing the world because they provide a dynamic, although vicarious, encounter through sound and vision (Collis, 1996). Moreover, they use a number of technical devices to manipulate that experience. Salomon (1979) called these devices "supplantations", in the sense that they supplant a cognitive process.

However, the use of video films in their present, mostly passive, form, do not succeed in contributing enough to the learning process (Clark & Craig, 1992). In active learning situations students are able to reflect, construct and interact (Laurillard, 1993, Bates, 1997). In such learning environments, students are expected to comprehend the structure of the lesson, integrate its parts and construct their knowledge through experienc-based actions. Present video-film learning environments do not succeed in providing such a model.

SYNOPSUS was designed to improve the passive "learning-by-viewing" model by reinforcing a shift to "learning-by-doing" while studying with educational films.

SYNOPSUS - An Educational Tool

By utilizing a user-friendly interface, the tool allows students to engage, on a computer, in active, reflective, and interactive learning with existing video films. By allowing students to actively summarize a video film, the tool encourages them to engage in active learning. While summarizing the film, students are creating their own personal model of the movie, its structure, and its contents.

When the observer decides to summarize the film (which is seen on the left side of a computer screen), he/she begins typing the summary. Immediately, the film stops running; the written summary appears at the right side of the screen and the last video frame is attached as an icon to the beginning of the text. Pressing the Esc function resumes the film, and the summary with its icon are framed in a box. Each time the observer begins typing, the film stops running and another summary appears with its relevant icon on the right side of the screen. At the end, the student has a list of blocks in each of which there is an icon representing the place of summary in the film, and a written text which can be printed. This list of blocks can be arranged according to their order in the film, or according to the order in which they were created.

By automatically attaching relevant video icons next to a summary block, the tool provides an easy way of visually remembering and keeping track of, and returning to, important points in the film. This capability encourages students to engage in reflective thinking since relevant sections of the film can be found and seen by clicking on an associated video icon that immediately moves the film to the intended section. Reflection is also aided by allowing immediate access to relevant sections in the film via simple word searches on the textual summaries.

The tool also allows instructors to prepare interactive questions and assignments pertaining to the film watched. The questions and assignments pop up when the student reaches a pre-specified point in a the film.

SYNOPSUS can be used for distance learners and for face-to-face teaching during frontal teaching sessions. By using the presentation mode of the tool, instructors can show predefined segments of a film along with their own headers and annotations.

An Evaluation Study

The Open University of Israel (OUI) is a distance learning institution. Some of the courses offered to students are telecourses which include as learning material a textbook, 26 video films and a student guidebook. A telecourse in psychology was chosen for a study of the new tool. Out of 400 registered students, 100 volunteered to try the software. They received two CDs: one contained the software and the other contained a thirty-minute educational film. The first 60 students who were willing to participate in the study (after experimenting successfully with the software), were divided into two groups of 30 students: In group 1 students received films 1 to 6 on CDs, and in group 2 students received films 7 to 12 on CDs. Both groups received all other films on video cassettes. The two groups were similar in average age, percentage of males and number of previous course credits. This design allows for between and within comparisons regarding the experience with the software and CDs on the one hand and video films on the other hand. A third group of eight students with learning disabilities served for an exploratory investigation into the possible advantages of the software for students with such difficulties. They received the same material as group 1.

A questionnaire will be sent to all three groups at three points in time: (a) after the allocated learning period for the first six films (CDs for groups 1 and 3 and videos for group 2); (b) after the allocated learning period for films 7-12 (CDs for group 2 and videos for groups 1 and 3) and (c) after the allocated learning period for films 13-18 (videos for groups 1, 2 and 3). Group 3 subjects will be interviewed individually regarding their experience with the software and its possible help in overcoming some of their special learning difficulties. At the end of the semester students will be asked to send their summaries to the research team.

The purpose of the experiment was to test learners' attitudes towards the learning tool as well as their learning processes while using it. The design of the experiment permits absolute evaluations as well as comparisons with learners who watch the films on the TV screen without the tool. The following hypotheses will be tested:

1. SYNOPSUS facilitates the process of summarizing the film.
2. Subjects summarize more and better with SYNOPSUS than without it.
3. SYNOPSUS facilitates concentration while watching the film.
4. SYNOPSUS facilitates the process of locating a specific subject in the film.
5. Subjects go backward and forward in the film in order to access specific segments of it more often while learning with SYNOPSUS than while learning without it.
6. Subjects enjoy the film more on a television screen without SYNOPSUS than on the PC screen with SYNOPSUS.
7. Subjects feel they learn more from a film they watched on a PC screen with SYNOPSUS than from one they watched on a TV screen without it.

SYNOPSUS will be presented along with some of the experiment's results that will be available at the time of the conference.

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Censorship or self-discipline on the Internet?
Strategies for limiting access to morally undesirable Internet resources.

John Boatright, MA
University of Minnesota
1283 Goodrich Avenue
Saint Paul, MN
boat0011@tc.umn.edu

Abstract: The purposes of the Internet are many; commercial, recreational, informational, educational, communicational, relational. The Internet is a paradoxical universe of structure and anarchy: producing some good and some bad, some beautiful, and some ghastly. There are many, educationally relevant Internet resources. "by the year 2000, anyone in western civilization will be able to get the answer to any question that has an answer" according to influential *Byte* columnist, Jerry Pournelle. In the 1997 Current Population Survey by the US Census Bureau computer use was surveyed. The study showed that three quarters of the children in the USA have access to computers at home or school - significantly more at school than at home. Children most frequently used home computers for educational purposes (93.3%) and games (83%). One fifth of the children who have home computers used them to access the Internet. For adults, 18 and over, 92 million people used the computer at home or work. More than half these adults accessed the Internet from home, with 80% of them using the web to access government, business, health or educational information. Significant increases on the order of 5-15% were recorded for every category of questioning over the 5 years span between surveys. In all, one of five Americans (ages 3 and higher) used the Internet in 1997[8].

This presentation/essay concerns controlling a kid's access to "morally undesirable" information. But before we can get to that, it is important to consider the need for such control. In the schools of our nation, our children are using the Internet to reach out of the walls and experience the universe. Free ranging access to the wonders of science and humanity can be had through simply searching the Internet using search programs. Any teacher or student deserves these resources and they deserve to follow the curiosities that are a contingent element of human intelligence. The question that arises involves the various interests of the purveyors of these archives. Some of these interests are illegal and even more are morally undesirable.

Introduction

The purposes of the Internet are many; commercial, recreational, informational, educational, communicational, relational. The Internet is a universe of anarchy and chaos: producing some good and some bad, some beautiful, and some ghastly. There are many, educationally relevant Internet resources. "by the year 2000, anyone in western civilization will be able to get the answer to any question that has an answer" according to influential *Byte* columnist, Jerry Pournelle. In the 1997 Current Population Survey by the US Census Bureau computer use was surveyed. The study showed that three quarters of the children in the USA have access to computers at home or school - significantly more at school than at home. Children most frequently used home computers for educational purposes (93.3%) and games (83%). One fifth of the children who have home computers used them to access the Internet. For adults, 18 and over, 92 million people used the computer at home or work. More than half these adults accessed the Internet from home, with 80% of them using the web to access government, business, health or educational information. Significant increases on the order of 5-15% were recorded for every category of questioning over the 5 years span between surveys. In all, one of five Americans (ages 3 and higher) used the Internet in 1997[8].

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Illegal interests are pursued and prosecuted in the United States by state and local law enforcement, the FBI, the US Marshall or the Federal Trade Commission depending on which jurisdiction the activity entails. The international nature of the Internet may bring other law enforcement agencies into the investigation and prosecution. In the US there are specific police resources devoted to cyber-crime.

On the morally undesirable side, there is no such concerted effort – in fact there seems to be a fair level of disagreement. While there is much media attention given to (thus far ineffective) efforts aimed at outlawing these undesirable Internet activities, there is a strange avoidance of discussion into exactly which information should be restricted. Consensus has arisen around some pseudo-illegal activities such as distribution of child pornography. But aside from that...almost certainly the literature simply starts off with the assumption that children need to be protected from whatever morally reprehensible activity the writer is imaging but not really describing. And, honestly, aside from acknowledging this vagueness, this writer is not much different.

The generally agreed philosophical rationale is that children from ages 5 to 18 must be protected from this information because they are not ready to contextually understand these darker fantasies and features of our culture. (In extreme cases -- I am wondering who is?) Kids are ignorant to the dangers that may be encountered through their venturing into knowledge unconditioned by experience. A loud debate rages about "how to stop access" to these dark media resources. When the next kids-killing-kids, school shooting incident occurs, our attention will be brought sharply back to the studies that widely implicate media's influence on a child's moral development. This research is not clear on the nature of the developmental harm associated with a premature familiarity of the darker side of humanity. We could wish for more specifics as to which type of media, how it specifically affects development and when in the child's development are they vulnerable to such influence.

For purposes of this essay, it will be assumed that *kids* need protection from morally undesirable elements of our culture even if adults do not. That further, the special media circumstance of Internet delivery of these morally undesirable archives directly into our schools and homes deserves our special attention. We will assume, as do many others, that an inadvertent curriculum can formulate around these dark and undesirable interests.

Since these fascinations with the darker elements exist in our culture, there is necessarily a developmental time when youth should gain controlled experiences in them. The school however is excluded from that objective – it is left to parents to control this curriculum. There are logical flaws in this plan (e.g. that parents often do not address these legitimate needs) will also be excluded from this essay.

This essay will assume that someday these "morally undesirable" graphical and information archives can be identified through public discourse and reasoning. Something beyond the "we will know them when we see them" criteria. Though there is no theory on whether it really is undesirable for children to be exposed to any of the following areas...and though there is no sharp delineation of the level at which information becomes damaging...the general content areas are well elaborated in the literature and involve concern about the following issues.

Inappropriate sexual displays.

There is a well-publicized and very active pornographic sector accessible through the Internet[7]. These resources may involve text or graphical displays that are developmentally inappropriate for children (and frankly adults!). This area receives much attention by the naysayers of open Internet access. It is said to represent a significant but small proportion of Internet informational traffic (I have seen figures of less than 10% - I cannot seem to find the source right at this moment though) Additionally, these sites often involve unscrupulous schemes to charge the viewer -- while claiming to be free of charge. It is a common family dilemma to have a surprise encounter with the financial consequences of a child's experimenting with Internet sex sites. Again, research is disappointing here, but in my circle of friends and family, children have spent thousands of dollars in this way. Anecdotally, costs associated with these episodes are confabulated with similar costs charged by cable and phone sex experimentation.

Predatory persons

There is a danger that children may be lured into meeting some predatory person, whose desire is to do them physical harm. While this danger is theoretically real, there is no frequency data available in the literature. It can be assumed though from reports of *adults* being lured out to meet predatory persons, that children would be also similarly vulnerable to such risks[22].

Financial Scams

There are a number of financial schemes communicated through the Internet. Pyramid schemes are popular -- so are offers "too good to be possible." Low interest, poor credit credit card offers are also frequently offered on the Internet. It can be assumed that the limited experience of kids would make them targets for these deceptive or illegal activities. Again, there is no data readily available on the incidence of children being victims. It is sufficient to say, that there are many adults that get scammed. We can be sure that if there were unlimited access to children for the scam artists and a source of credit for the children, there would be a significant level of risk to the financial well being of families and children[27].

Privacy concerns

The issue here is that children might give out information that could physically target them for predators. Another concern may be that the child, not being aware of the risks, may innocently or out of bravado arrange a connection with an unsavory character[21,22].

System integrity and security issues

There might be risks to the stability of the network due to downloading programs that originate from certain Internet sites. There is a fair amount of Internet traffic visible on lists associated with "hacking." (search keyword "crackers") The substance of these messages often reflects an interest in illegally obtained software and passwords to various nefarious sites. An easy and more popular invasion of networks involves reflecting junk e-mail ("spam") from the users domain so that it will appear to be from your computer system. I work for a women's college in the upper Midwest and we discovered that advertising for a pornographic site was using our domain as a reflector...to the extent that in one night 60,000 emails had been distributed! This, of course, was unacceptable to our network administrators. Protection from this type of hacking has been installed. Another concern is viruses and virus hoaxes. Aside from the damage an actual virus can do to networks, the volume of messages that virus hoaxes can generate is in itself, a plague.

Harassment

It is possible for a predatory person to stalk and harass a person via the Internet. Especially if used in combination with other modes of information accessible through the Internet or other information providers. Phone numbers, addresses, maps may assist the stalker to find their target repeatedly. It is more and more difficult to "disappear" if one needs to. One source listed the costs for information on the a person as $15 for social security number, to $150 for a complete background check.

Internet "addiction"

While dubious as a real disorder, some people spend inordinate, obsessive amounts of time on the Internet[3,4,11,12,13,14,15]. Sometimes this interferes with normal activities of daily living. The fear is, that introducing Internet use in schools give tacit approval for obsessive use of the Internet. There is no empirical data available in the literature, but based on anecdotal evidence (again from families and friends) teenagers are known to sacrifice duties and sometimes sleeping in order to use the Internet. Recently, the American Psychological Association gave some context to the question during a symposia on the topic. They concluded that pathological internet use was possibly an addiction, a disorder or a symptom of depression.

Abuse of credit

A problem not exclusive to the Internet, there cannot be any doubt that the Internet is a good place to spend a lot of money. Many Internet retail and service sites exist and accept credit cards. It is easy to rack up an impressive bill in a few hours of Internet shopping. Amazon.com for books, records, presents; Quill for office supplies; LandsEnd for clothing; EggHead for software; Dell for a computer; Auto.com for a car; ebay for a boat; pretty soon you've spent some bucks!

Depression

There have been articles in the psychology literature about a relationship between Internet use and depression[5,6]. The debate rages on with both side positing credible pros and cons. The crux of the issue here is the chicken/egg problem. That is did the depression precede the use of the Internet or was depression a result of Internet use? Currently the theory that seems most favored is that use of the Internet is more a symptom than a cause of depression.

Academic integrity

A virtual industry has evolved selling term papers to students. Keyword search on "term papers" revealed 100s of sites devoted to free and for sale papers. Many services offered custom services. According to "Paper-Masters" their custom written term papers are meant to be research to assist you writing your own paper. They conclude that it is not in any way unethical to use their services.

Identity

The relative anonymity provided by the Internet is a challenge to individual identity. This feature also allows people to fabricate an identity that is quite different from their own. The concern is that this fantasy identity may interfere with the identity forming process that is an important in the child[34].

Community

There are fears that rather than encouraging community and multicultural exchange the Internet actually encourages isolation.[2]

Intellectual property

Many teachers report a cut and paste form of writing where the students simply search out information on the Internet and then copy it directly into their papers without quotation. Additionally copyright infringement rules are very difficult to understand within the context of the Internet.

Social accountability

The anonymity and 2 dimensionality of the Internet does not foster authentic relationships. This issue is the converse of the safety afforded by the electronic distance of the Internet. One concern for kids is the negative role model that this demonstrates. The superficiality of complex individuals as represented on the Internet is also an impression that is unrealistic. On the Internet, as with other media, the distinction between real an imaginary is difficult to detect.[36]

Review of the literature

While it this essay is focused on educational issues in American schools, it is interesting to observe that in Europe several countries (GDR, GB and others) have also sought to control certain types of Internet communications. Great Britain actually has a complaint bureau, The Internet Watch Foundation[1], where consumers can expect to see prosecution of child pornography, and other harmful activities. The bureau expressly stays clear of controversies into items of political or social question though. Internet access is severely limited at the source - the Internet access hub, in several Middle Eastern countries (Saudi and Egypt). All accessible sites are government approved even email is scrutinized.

In the United States, a first Amendment disagreement has arisen over Internet control. The US Supreme Court has made four determinations in favor of free Internet access for anyone able to get there. Though there are plenty of details left to interpretation, the court has made sweeping statements about the freedom of the Internet. Congress continues to contemplate legislative action, intended to circumvent the Supreme Court's First Amendment rulings and control some types of Internet communications. As stated before, illegal activities are prohibited and prosecuted in multiple ways, the debate concerns pseudo-legal and legal but controversial Internet resources such as child pornography, bomb-building directions, racism, slander, misinformation.

Strategies for limiting the access of kids to morally undesirable Internet archives

Free access to all:

It would seem that this is what we have. This is a common misconception of the Internet. Certain types of information cannot (currently) be transmitted via the Internet. The interface is restricted to materials that are comprised of an audio, visual and/or digital nature. Certainly this covers a lot of ground, but in reality this is a significant limitation from the start. Not everything the human has a capacity to sense can be transmitted by the Internet.

Additionally, and of more relevance to the theme of this essay; illegal activities are prohibited on the Internet. As stated above, several governmental policing agencies monitor and in fact utilize the Internet to investigate and prosecute criminal activities[1]. Email threats are taken quite seriously – the appearance of treasury, secret service officers at a local high school last year to arrest a student for having sent a death threat to President Clinton is lesson enough to prove this point. Drug and firearm enforcement agencies also monitor the Internet for signs of criminal activity.

Direct adult supervision:

There is a tacit rejection of direct adult supervision as a control strategy in almost all the literature[30]. It is felt unrealistic that an adult mentor could monitor a kids Internet adventures, or help them gain context if they bump into something morally undesirable. The literature in this area occasionally mentions that this is an option, but that then goes no further than to state it is simply not feasible for presumably practical reasons. There is, however, agreement that this method of control would be desirable and effective. This writer is not so sure that this is the contingent difficulty with the idea. Challenges here may be more associated with the problems of communicating with our youth. Adults are really hesitant to talk about morally challenging topics – a sudden view of human sexual interaction might initiate questions – and that would lead to a difficult conversation. Teachers should be allowed to have this kind of conversation with our youths, but the onus of responsibility is on the family where it <dismay> rarely occurs.

User Self Policing - Moral development and the Internet

It could be left to the user to restrict their own access by virtue of their own experiences[35,36]. This highly improbable suggestion centers on development of a personally held and derived dislike for morally undesirable Internet resources. It can happen, and most probably does, after the thrill is gone so to speak. The impractical part of this suggestion is not the philosophically sound grounding that exists in allowing people to morally develop, but rather the political impossibility of implementing such a plan in a country founded by the Puritans. Additionally, there is much to be said for the idea that a staged approach with contextulization would need to be implemented to coincide with the developmental capacity of each individual kid. Given the performance record of our public schools…it is utopian to imagine such a strategy could be harmlessly implemented.

Legislation:

Communication Decency Act (CDA) and Son of CDA – overturned by the US Supreme Courts. Ruled as unconstitutional by virtue of their violation of First Amendment rights[10]. Politicians continue to bring up legislation that the American Civil Liberties Union defeats in court challenges. Literally millions of dollars have been expended in the quest for legislation that can get through the first amendment tests. Often the problem is that the definitions for morally undesirable materials cannot be specifically measured, and could thus be applied too widely.

Acceptable Use Policies (AUP):

As an aide to self control, a signed statement of appropriate internet use AND the consequences of abuse of privileges is used. Samples of AUPs are available on the Internet. AUPs are used in nearly all networked computer labs. It is necessary that some person observe the Internet use in such situations. This can be done by walking around the lab or by looking at the log of Internet addresses that has been accessed on a particular computer. It would seem very possible to automate this observation of a lab by sharing the log with a central teachers workstation, but there was no mention of this strategy in the literature. See references[31] for a link to an example provided by Rice University.

Rating Systems:

A strategy familiar to moviegoers is common of the Internet – warning the consumer of adult content. Most commercial (even free) adult sites require the user to physically confirm select their intent to utilize the morally undesirable archives. Some Internet businesses have arisen that claim to restrict the access of minors to their sites by virtue of credit card credentials. Of course, a credit card has little to do with verifying age – these sites are more interested in connecting interested parties (and their credit cards) with their cadre of pornographic vendors. The intent is to protect the inadvertent viewing of these resources, but of course, many curious 15 year olds are undeterred by these warning and click right through.

Screening Software:

It would be nice if software could be developed to filter morally undesirable Internet content, but thus far efforts have been only partially successful.[26,27,28,29,30] Current filtering software can be grouped based on the strategy used to filter. One group uses keywords, taken from a ready made list of dirty words, to eliminate access to undesirable Internet archives. Often the list can be modified by the administrator to add new words or to add in a miss spelling of the particular dirty word of concern. This is effective but suffers from the problem that sometime dirty words also have morally desirable alternative uses. For instance "breast" as a keyword will also eliminate sites concerned with breast cancer. Another approach is to keep a list of either acceptable and unacceptable sites. For instance sites ending with the ".gov" suffix are approved, Disney.com is approved, a list of sites that are not approved is provided and updated by the software company and can be modified by the administrator. Unfortunately, the undesirable element of the Internet moves around a lot, and new morally undesirable sites are launched every day, so it is easy to imagine that something will get past the filter.

Network Filter programs:

Similar to screening software, more sophisticated filters can be installed at the network hub[30]. This is the strategy used by those Middle Eastern countries to prevent access to certain internet resources.

Intranet strategies:

One strategy taken by some schools has been to simply offer only internal versions of Internet available resources. It's a sort of smaller, internally stored version of the Internet. WebWhacker[30] whacks entire sites out of the Internet and stores them on your computer network. This strategy is fine as long as the learner only asks questions available within the limits of the stored information. An encyclopedic resource, and other informative resources are made available. Often access to the external Internet is possible for special situations, and can be more effectively monitored.

Internet watch groups:

Another way used in concert with screening software is to have a group of evaluators monitor the moral permissibility of Internet sites[30,33]. What happens is that a software company or a school enlists the help of a screening committee. Their function is to expand the list of forbidden and permitted Internet resources.

Free market pressure and industry self regulation:

Especially during the legislative debate on CDA, many Internet Service Provider companies became concerned over the trouble it might be if they could be held responsible for Internet content. America Online, the largest Internet Service provider, initiated a program of parental controls that allow various levels of access control over the Internet and AOL network resources[1,17,18]. Also, they developed a system of "moderators" to monitor kid chatrooms, as well as a responsive complaint system. In other words, they felt it was good for their business interests to allow the user to determine limits on access.

Conclusions

So what is the big picture here? First, this is a new experience to all of us, second the Internet needs to be a vital part of the learning experience for kids, Third we will not be able to bring ourselves to restrict anything but illegal activities from the Internet – and even here it's a post hoc analysis.

Clearly the best choice is to design a system where Internet use is closely monitored, but not for punitive purposes, but for contextualizing by adults who are skilled and vested in helping kids see our world, all of it at the right time. Since this is so impossible given our current factory model schools, I would recommend the strategy where much of the information needed by students is anticipated and locally stored on school friendily servers – a second network soto speak. When kids need to venture onto the Internet let them, and be there for them.

There is much research that needs to be done, but some of the important questions IMHO (in my humble opinion) have to do with cultural changes that will come as a result of this new dimension. Questions about moral development, community and diversity seem largely unstudied. Philosophical and psychological issues such as what really is inappropriate and at what developmental age are barely disturbed. Finally, I wonder what the future will hold for new ways to communicate human sensations and feeling will be.

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Using Speech Recognition to Support Online Learning of Second/Foreign Languages

Francis Bonkowski, IC Education, Inc., Canada
Quinn Cheung, IC Education, Inc., Canada
Liam Cheung, IC Education, Inc., Canada

This paper presents IC Education's state-of-the-art pedagogy and technology to support online language learning. IC Education has developed speech recognition over the Internet using a new client/server application that recognizes the voice of user's without having to install complicated software on a personal computer. The system entails minimal software installation by the user and provides centralization of the speech recognition engine. This innovative technology is a powerful, albeit simple tool used to teach learners proper pronunciation and new vocabulary.

A BUILDING-BLOCK METHOD FOR COURSEWARE DEVELOPMENT FOR LESS-EXPERIENCED DEVELOPERS

Eddy Boot & Yvonne Barnard
TNO-Human Factors, Soesterberg, The Netherlands
Kampweg 5, P.O. box 23, 3769 ZG Soesterberg
Email: boot@tm.tno.nl, ybarnard@tm.tno.nl

Abstract: *Although courseware has the potential to increase the efficiency and effectiveness of courses, until now the results of its application is often disappointing. In our research concerning courseware development within the Royal Netherlands Army (RNLA), we investigated some of the underlying reasons for this, and specified an approach to promote its applicability. One of the main problems is the high cost of courseware development, resulting from the long development time and the specific expertise required. We constructed a 'building-block' approach, which enables instructors with limited multi-media expertise to rapidly develop courseware for simple learning objectives, but with the use of advanced multi-media technology,. This approach consists of templates that incorporate sound didactical principles, lower the technological complexity of courseware development, and can be used within modern authoring tools. Currently we are implementing the method and are studying how to enlarge the scope of the method towards more advanced learning goals.*

The use of courseware

Recently, the interest for the use of courseware within many educational and corporate organizations is increasing in a rapid pace, as it has the potential to increase the efficiency and effectiveness of courses significantly. Organizations want to develop courseware in-house, as in most settings Commercial Of The Shelf (COTS) courseware is not specific enough and currently modern, powerful authoring tools are available. However, in many cases such attempts have been disappointing in terms of contributing to efficiency and effectiveness of (the development of) training programs. For instance, in the last few years, the Royal Netherlands Army (RNLA) has spent considerable time and effort in developing courseware for its Training Centers. This courseware mainly directed at concept learning and procedural tasks. However, the application of courseware has not yet lived up to its expectations. It has never been very cost-effective and (therefore) organizational acceptation or broad adaptation of courseware within training programs is still not accomplished.

Bottlenecks in developing courseware

TNO-HF has been asked to investigate this problem and to formulate, implement and test solutions for it. We found a number of problems concerning courseware development (Boot & Van Rooij, 1999). The development of courseware is mostly done by Subject Matter Experts (SME's) and instructors, using modern authoring tools. Despite the efforts and promises of these tools to reduce development time and the level of required expertise (e.g. Asymetrix, 1998), it still takes considerable time (and therefore costs) to produce courseware. We found that considerable programming knowledge is required for anything more that very simple courseware. Also, much time is required to familiarize with the tools and its many features and the translation of didactical models into courseware is complicated. In the RNLA, the SME's and instructors lack the didactical-, multi-medial- and programming expertise to make optimal and efficient usage of these tools. One can conclude that the development of anything more advanced than very simple courseware programs, remains costly and will be only cost-effective for large target groups.

The building-block approach

If one aims at courseware with advanced technological features (in terms of multi-media usage and interactivity), developed by people with limited programming expertise, a so-called 'building-block' approach can be a solution. This approach pre-structures the development-process by offering templates within authoring tools. Templates consist of empty courseware-structures to be filled with content. These structures incorporate sound didactical principles and advanced technological features. Once connected to each other (hence the name building-block approach) and filled with content (the learning materials), they constitute a complete courseware program. We investigated some build-in pre-structuring features of modern authoring tools that make the same claims, but they are too limited for our purposes. Therefore, our templates should be more advanced and comprehensive, in order to promote proper implementation of didactical models and lower the technological complexity. As standardization, re-usability and exchangeability of courseware(elements) is a key issue, these templates should be embedded within COTS authoring tools.

Specification and implementation of the approach

We specified a building block approach for the RNLA, with templates for four levels of courseware-structure (Boot & Van Rooij, 2000);

1. At the top level, templates provide different kinds of navigation through a number of lessons.
2. At the second level, templates provide different kinds of navigation of learning activities within lessons.
3. At the third level, templates provide interactivity within learning activities.
4. At the bottom level, templates provide the presentation of multi-media elements within learning activities.

Altogether, they contribute with standardized screen-elements to the complete user-interface of the program. The didactical functionality, embedded in the templates, is directed at relative simple learning goals; learning facts, concepts, procedures and principles. The instructional strategies that are embedded are based on theories like Gagné's Nine Events and Merrill's Component Display Theory as found in Reigeluth (1983). Technically, the templates are build using Knowledge Objects® within the authoring tool Authorware® Version 5, and are provided with Wizards for guiding the interaction with the developers. For reasons of acceptance and commitment of the future developers, we have involved them during the specification process of the building-block approach. We found that it is important and difficult to balance well between how much templates should prescribe and which freedom remains for the developers.

Currently, we are in the implementation phase; external software developers are building the templates, after which they will be used by some developers within the RNLA. We will start a number of pilot projects to evaluate the application of the approach and the resulting courseware. Based on these results, the templates can be improved and the building block approach will be applied on a wider scale.

Future developments

One important aspect of our research is yet unresolved; how to specify a building-block approach that is also directed to more complex courseware? During specifying the described approach, we found that finding a sound theoretical basis is troublesome. It is a challenge to embed didactical models and instructional principles into software-templates that are content-empty. Our future research will be directed at embedding didactical models for advanced learning goals, using principles from learning theories like constructivism and situated cognition. Our goal is to formulate concrete guidelines for the problem-based or case-based approaches from such theories, and implement and test these within an advanced version of our current building-block approach.

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Collaborative University Teaching over the Internet

Jacqueline Bourdeau, Department of Education
Université du Québec à Chicoutimi, Chicoutimi, Québec, CANADA G7H 2B1
jbourdea@uqac.uquebec.ca

Abstract: A concept has been developed to achieve various forms of collaborative teleteaching, such as sharing ideas about teaching, using learning scenarios, and engaging in joint teaching actions. Professors play a key role, since they are instrumental in integrating new technologies into teaching. An environment is being developed to encapsulate an instructional design technique to facilitate sharing processes. A database technology provides distributed services over the Internet.

From Teaching to Teleteaching

University teaching has traditionally been defined as an on-campus activity where all players (1 professor and X students) are in the same place at the same time, with or without any media. In fact, all teaching has been based on these parameters. New technology (NT) brings many potential changes to these parameters, since it creates an opportunity for innovative distributed teaching modes. This potential has increased the need for instructional design, and consequently the progressive transformation of traditional teaching modes into instructional design-based teaching. Integrating NT into teaching implies changing teaching practices. Integration has taken various forms in higher education, such as: Web-based instruction, online education (www.telelearn.ca); videoconference-based teaching (Bourdeau & al., 1998); the virtual campus (www.tecfa.unige.ch), or integrative distance learning environments (www.licef.teluq.uquebec.ca). Satisfaction levels in students and faculty vary from enthusiastic to negative. Faculty is being pressured to digitize material in the form of electronic books, or add electronic communication to their classroom teaching. However, teaching continues to be based on the synchronization of professor and students in a given space. There is room for integration modes, which could be better anchored in current practices, while simultaneously fostering greater faculty involvement.

PETRUS: The Concept

Petrus is a new concept developed to integrate new technology into university teaching. The fundamental characteristic underlying the idea is to consider professors the driving force behind educational integration, since they are the agents who design teaching specifically for their own students. The integration of new technology derives its meaning (direction and semantics) from their teaching and personal interpretation. The second one is to consider new technology a catalyst rather than a tool: the spirit of the Internet is all about sharing and cooperation. A good number of professors are clearly prepared to integrate this spirit into their teaching. And lastly, the third characteristic of Petrus is to provide professors with a computerized environment where the groundwork for an instructional design technique has already been laid through scenario-building. Depending on their preferences or needs, professors can use the ScenarioBuilder in Petrus to: 1) assemble dynamic instructional scenarios, 2) gain shared access to comprehensive, validated scenarios, 3) select individual components from scenarios.

Implementation Plan and Work in Progress

Implementing sharing practices requires sharing processes and an environment designed to support these processes. Scenario-building skills can be acquired through a high-quality system where instructional principles have been built into an expert environment. Professors can access, consult, edit or assemble scenarios in the most flexible ways. They also have the option of designing their own teaching environment and learning interface for students. Teleteaching services naturally have to be anchored in current teaching practices and jointly designed with professors. The following plan was designed for a course on learning theories: 1) Collect and analyze a series of syllabi on learning theories; 2) Extract and classify items according to objectives, content, learning/evaluation activities and material; 3) Conduct a needs assessment of useful teleteaching services; 4) Choose software engineering solutions; 5) Develop and test a prototype for one course; 6) Develop and test a prototype for five courses on distributed sites; 7) Develop a full environment including rights and privileges. The plan is currently under way after a team of professors agreed to jointly design and test the scenario-builder. Steps 1 through 5 have been completed, and a Web-based prototype environment is being developed. The environment will be served by a database that dynamically feeds information into the system. First results will provide information on the quality and level of interest in collaborative teleteaching for a course on learning theories in teacher education programs.

Related Projects

To the best of our knowledge, the concept that comes closest to Petrus is ARIADNE, which stands for Alliance of Remote Instructional Authoring Distribution Networks for Europe (http://ariadne.unil.ch/). The project focuses on the development of tools and methodologies for producing, managing and re-using computer-based educational components and curricula. Collaborative approaches are encouraged, as is the share-and-reuse principle (Duval, 1999). Petrus is radically different in that professors are at the centre of all processes; they are the agents through whom everything passes, and both their personality and teaching style are incorporated into the design. Petrus is not looking to set standards, but seeks diversity instead in terms of intellectual perspectives and teaching styles. Secondly, Petrus contains a scenario-builder that incorporates teaching strategies which can also be shared. The STAR.Legacy project (http://peabody.vanderbilt.edu/ctrs/ltc/) at Vanderbilt University has some features similar to those of Petrus: the learning cycle resembles the Petrus Scenario-Builder and, and the "multiple perspectives" activity in the STAR Legacy learning cycle is characteristic of a team-teaching situation. The working hypothesis underlying the Petrus project is as follows: the successful integration of digital technologies into university teaching must go through the professor – an expert in a particular domain who is responsible for conveying information, inspiring and coaching students to help them achieve their personal, academic and career goals. Professors need to customize the learning environment for their students, and change it as needed. Professors would ultimately be engaging in team teleteaching. Videoconferencing and video servers would provide a multitude of perspectives for students, thus enabling them to acquire greater discernment and critical skills.

Sharing, Collaboration and Teleteaching

In the context of computer-supported collaborative work, sharing is seen as a sub-process of collaboration, which is itself a combination of communication and coordination. Coordination science defines coordination as managing interdependencies, and this concept can be extended to the management of interdependencies among actors (Bourdeau & Wasson, 1997). In the Petrus project, sharing processes can be identified together with their associated interdependencies. The software environment would be built around these interdependencies and provide the means to manage them. Examples of sharing processes include: sharing ideas, scenarios, teaching or coaching activities and lessons learned. Mentoring (at the novice or expert level) can also be considered a sharing process. Examples of sharing principles include: reciprocity, privileges, task distribution, resource allocation, and so on. Software to manage and support sharing processes will be designed when sharing processes are identified and validated, and means for managing interdependencies are developed. Ethical and legal issues will also be taken into account.

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Credits

The project was launched in 1998 through a subsidy by the Université du Québec FODAR Fund to a team lead by Jacqueline Bourdeau and comprised of the following professors: Samuel Amégan, Pauline Minier, Luc Morin, UQAC; Hélène Poissant, UQAM; Albert Boulet, Jacques Chevrier, UQAH; Serge Tremblay, UQAT; Jean-Yves Lescop, TELUQ; and Blaise Balmer, UQTR.

SEBASTIAN: Educational System Based on Internet Technology

José Luis Carrasco Sanz, Liliana Patricia Santacruz Valencia, Carlos García Rubio,
Peter T. Breuer, Carlos Delgado Kloos, María del Carmen Fernández Panadero

Telematic Engineering Area
Universidad Carlos III de Madrid
Avda. De la Universidad 30, 28911
Leganés – Madrid – España
sebas@it.uc3m.es

Abstract: This paper describes the work of the Carlos III University in the project SEBASTIAN (Educational System based on Internet Technology). The aim is to develop a tele-educational tool, providing to educators/trainers with a simple mechanism that makes possible the use of the network for the broadcast of educational content and enabling the creation of multilingual courses based on XML (Bray, 1998) and SMIL (Stephan, 1998) technologies.

Introduction

As soon as web technologies first became available, they were adopted for educational purposes. Hypertext technologies had already been used in learning systems, and the Internet facilitated the overcoming of distance. Higher education is now undergoing structural changes in terms of the composition of student populations, learning paradigms and curricula. As distance education becomes an integral part of higher education, student bodies are expanding to include more non-traditional students and the contents of courses are richer than before, and incorporate more interactivity.

In this new world, students participate more actively in class and collaboration becomes a more important component of the learning process. These changes have stimulated the development of new ways to represent information (for example: animations, simulation, hypertextual navigation and so on). In particular, multimedia content has been introduced via the medium of the WWW. However, there are problems associated with the variety in present day formats. Facing up to this situation, The Carlos III University of Madrid is working on a project named SEBASTIAN.

System Architecture

The system serves to integrate multimedia learning experiences into the network enabling it to be visualized according to the preferences and characteristics of the student. The courses generated are described in EML 2.0 (Educational Markup Language 2.0). This language is based on XML and includes spatial information (multimedia objects place, presentation size, etc.), temporal information (duration of multimedia objects, scenes, etc.), and information about students profiles (learning styles). The professor will eventually have one tool with three integrated functionalities for the creation of courses, see [Figure 1]. The functions are:

- **LG (Layout Generation):** Allowing the description of the spatial distribution of multimedia elements that comprise each scene of the presentation. A description language, SLML: Space Layout Markup Language (based on XML), has been designed for this purpose. This functionality will provide the creation of multimedia templates. Initially, some predefine templates will exist, but the object is that professor generated its own templates.

- **STG (Synchronous Text Generation):** The files generated are based on a new language STML: Synchronization Text Markup Language, and provide textual content in several languages. These files contain synchronization labels which synchronize the text with audio or video, as in a karaoke session.

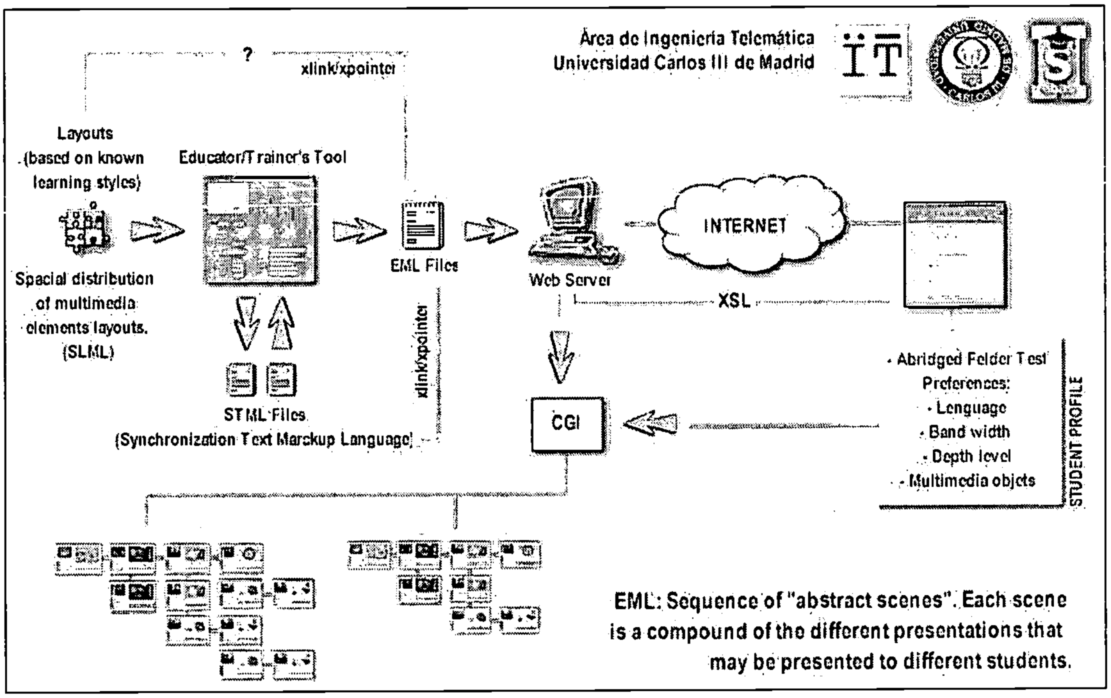

Figure 1: Contents generation, distribution and visualization process.

- **CG (Course Generator):** Integrates multimedia files and files generated by the two previous applications. The result is a presentation composed of a sequence of "abstract scenes". Each scene is a compound of the different presentations that may be presented to different students. The view presented to each student depends on their preferences and pedagogic profile. These profiles are generated automatically in accordance with the Learning Style Model (Richard Felder, 1996), the PAPI (Public and Private Information, 2000) and the LOM (learning Object Metadata 1999) specifications.

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The Construction and Evaluation of an Internet-Based Knowledge Integration System (IKIS) For a CAI Graduate Course

Mei Chen & Tanya Scott
Department of Education
Concordia University
1455 Maisonneuve Boulevard W.
Montreal, Canada, H3G 1M8
MeiChen@vax2.concordia.ca
TScott@Education.concordia.ca

Abstract: This paper describes an on-going project that involves the construction and evaluation of an Internet-based Knowledge Integration System (IKIS) developed to support a Computer-assisted Instruction (CAI) graduate course. The IKIS integrates cognitive theories of learning and instruction, computer networking technologies, and face-to-face classroom teaching in order to (a) help students build coherent knowledge representations of a great variety of knowledge and skills that are required to design and produce instructional software prototypes and, (b) create a community of practice to aid students in making the decisions concerning the design and production. Our discussion will be focused on two important system features of the IKIS (i.e., the information architecture and communication facilities) that enable us to achieve such goals. A plan for evaluating the IKIS will also be briefly described.

In this paper, we will describe an on-going project that involves the construction and evaluation of an Internet-based Knowledge Integration System (IKIS) developed to support a Computer-assisted Instruction (CAI) graduate course in which students will develop knowledge and skills for designing and producing instructional software prototypes. Understanding of various design concepts and approaches, specification techniques, authoring tools, and development methods is emphasized within this course. Whereas the instructor of the course provides face-to-face lectures, demonstrations, discussions, and laboratory work, the complex nature of the subject can still pose a challenge for students to assimilate and integrate such knowledge. Furthermore, traditional classroom instruction remains an inadequate method in providing timely instruction to each individual student. The IKIS for (CAI) was constructed to (a) provide students with a rich, well-structured knowledge base in order to ensure their active assimilation and integration of a variety of knowledge and skills to be learned, and (b) create a community of practice to aid students in making the decisions concerning the design and production of software prototypes.

The Design of the IKIS

The IKIS integrates cognitive theories of learning and instruction, computer networking technologies, and face-to-face classroom teaching to enable students to use the well-structured knowledge base and diverse tutorial resources to build coherent knowledge representations of the subject-matter knowledge to be learned. The design of the IKIS is based on the cognitive theories of text comprehension that emphasizes the importance of structured knowledge presentations in the construction of coherent knowledge representations (Kintsch, 1988; 1998; Mayer, 1999; 1997), and on situated theory that views social interaction and collaboration as crucial factors in the development of scientific understanding (Lave & Wenger, 1991; Resnick, Levine, & Teasley, 1991). In addition, the *cognitive apprenticeship* model proposed by Collins, Brown, and Newman (1989) also informed the design of the IKIS. Five principles are articulated to guide the design of the IKIS: (a) providing a rich knowledge base to reflect expertise in the domain of instructional software design; (b) providing a well-organized and transparent knowledge structure to help students construct a coherent conceptual representation of the subject-matter knowledge, (c) employing an effective model of instruction, (d) building a community of expert practice and providing multiple perspectives towards the solutions and, (e) facilitating collaborative learning among students. The theoretical foundation and design principles of the IKIS have been described in details elsewhere (Chen, 1999; Chen, 2000). In this paper, our discussion will be focused on two important system features of the IKIS, namely the information architecture and communication facilities that reflect the principles described above. In addition, an evaluation that we will conduct in the near future will also be proposed.

The information architecture incorporated into the IKIS

The CAI graduate course is focused on the user-centered design for Computer-supported Collaborative Learning (CSCL). A series of topics were identified as important for successful design and implementation of instructional software prototypes. In order to help students construct coherent knowledge representations, the IKIS incorporates an information architecture (i.e., a hierarchical organizational scheme) to represent two "layers" of the knowledge to be learned: the first layer consists of various topics, which range from learning theories to web authoring techniques whereas the second layer is a breakdown of knowledge on each topic which includes concept, rationale, goals, methods, example, related issues, trouble shooting and tips, and reflective questions and exercises. Such a knowledge base is expected to enable the students to answer questions concerning what, why, how, to evoke reflective thinking, and ultimately, to create a rich context for students to engage in productive group discussions on the topics via computer-mediated conferencing. Furthermore, some Internet resources and lab tutorials that are relevant to specific topics are also provided to extend the knowledge base of the IKIS. Students can also access a perquisite-course website to acquire background knowledge if they wish. The information architecture of the IKIS enables the students to learn the topics in a logical manner, meanwhile this architecture is flexible enough to allow each individual to take a different navigation path based on his or her own selection. There is a navigation bar located on the top of the screen that allows students to maneuver through the course topics and breakdown by following either a pre-determined sequence or a selected path. In addition, a bottom navigation bar is available all time to enable the students to access a computer-mediated conferencing facility, newsgroup discussions, and e-mail addresses in the context of reviewing the course topics and breakdown. This bottom navigation bar also provides accesses to the resources and lab tutorials outside of the instructional content that is defined in the IKIS. An on-line help, site map, and search facility are also provided by the bottom navigation bar to enable students to navigate efficiently through the site.

The communication facilities utilized in the IKIS

There are numerous decisions that one must make in the processes of designing and producing instructional software prototypes. No matter how rich the knowledge base is and how well such knowledge base is structured, students may still have unanswered questions. The purpose of proving the accesses to a computer-mediated conferencing facility, newsgroup discussions, and e-mail addresses is to enable students to discuss such unanswered questions with their peers or experts outside of their physical environments. Three communication channels are established to support students' knowledge construction and decision-making: (a) *a channel for integrating with the peers*: the FirstClass™ software program is used to provide computer-mediated conferencing and chat facilities to facilitate the discussions among students. Each student is required to provide answers to the reflective questions that are proposed at the end of each topic. Students are also encouraged to bring up issues that they wish to clarify and respond to each other's questions. Students can also the FirstClass™ to exchange electronic files that they produced for their group work. The instructor and teaching assistant will monitor the discussion and provide directions and clarifications if needed; (b) *a channel for participating in the communities of practice*: The IKIS provides students with access to the Internet newsgroups that are most relevant to the topics discussed in the course. These newgroups are organized in a way that is sensitive to the course topics so that the students can be exposed to multiple perspectives on a given issue. Students will also have the opportunities to share their experience and expertise with people who face similar problems and understand the concerns of the practitioners in the community; (c) *a channel for* communicating with experts: In addition to the communication with the instructor of the course, students can ask questions to some design experts who will serve as the mentors during the course of the semester. These experts will help the students diagnose some "unsolvable" problems and provide suggestions via e-mail. In addition, a list of e-mail addresses of the experts in the fields relevant to CAI design will also be provided to allow students to contact these experts. The communication with these experts may provide students with insights into how experts think and practice. Thus, The communication facilities offered by the IKIS will break the boundary of time and location that is inherited in traditional teaching.

The Evaluation of the IKIS

The IKIS will be evaluated both formatively and summatively. In the formative evaluation phase, a few representative students will be asked to "walk through" the environment and provide "think aloud" protocols for making diagnosis of the system in terms of its usability and learnability. Following the necessary modifications, a summative evaluation will be conducted to determine the effectiveness of the IKIS. Two groups of students will be compared: one that use the IKIS and another that use a print-based version of the same material. An attitude questionnaire will be administered before and after the course to determine the changes in student attitudes. In addition, students' on-line discussions and course work will also be analyzed to determine the levels of expertise developed. The ultimate goal of the project presented here is to understand the ways that computer technologies can be used to enhance student learning of complex subject-matter knowledge and to develop a model of successfully integrating technology into the classroom teaching.

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Design decisions in the development of modular instructional content: Describing the transition from local to global learning systems

Paul Cholmsky
Concordia University, Montréal, Québec, Canada
cholmsky@videotron.ca

1. Introduction

Although the increasing sophistication of computer-based learning systems has enabled gains to be made in terms of their pedagogical effectiveness, an undesirable consequence of this sophistication has been a significant increase in development cost. The high cost of these systems has been identified as a principal barrier to their widespread deployment. Increased complexity in learning systems has also led to lengthier development cycles, which has constrained the rate of design evolution and innovation. As a result, there is a pressing need for instructional designers to focus on the efficiency of their development processes as well as the effectiveness of the outputs that are produced by them.

A possible strategy for reducing the time and cost of system development is to create a context wherein whole systems would not have to be designed largely from scratch. A key aspect of such a strategy could be the establishment of cross-organizational standards that would allow developers to reuse content components from other systems, both from within their own organization and from external sources. In essence, this would represent an attempt to leverage the productivity gains from reusability that have been achieved in software engineering into the domain of instructional content development. Over the past year, coordinated proposals have rapidly emerged from several bodies (e.g., Advanced Distributed Learning Initiative, 2000; Anderson, T., McArthur, D., Griffen, S. & Wason, T., 1999) as candidate standards for this purpose. As these proposals are vetted through their initial trials in actual learning systems, it will be important to observe how standards for content reusability affect instructional content development methodologies. Will processes primarily developed in the context of authoring content in small-scale closed systems evolve smoothly into processes for architecting large-scale distributed learning environments where the number of distinct content components may be in the hundreds or thousands? Conversely, if new processes must be developed, which ones will be required, and on what basis do we start their development?

A fundamental issue that needs to be addressed in this regard is the broad function of instructional design (ID) in the development of systems that have a substantial information technology (IT) component. Where does ID stop and IT start? Consider the development of a set of interactive practice exercises that include variable remedial feedback based on learner response patterns. A design decision could be made to use a database-driven approach wherein feedback is assembled from low-level content components that are sourced from a database. If these low-level components include subject-matter terms and their definitions, the same database might be used to drive a glossary function in the learning environment, serving the objective of content reusability. In designing such a system, we would likely not expect an IT professional to author the subject-matter definitions that lie within the database, just as we would not expect the ID professional to design the software that allows the database to communicate within a client-server environment. Appropriate allocation of responsibility for many other design issues, however, is not as clear-cut. For example, is one of these professionals primarily responsible for decomposing the feedback into suitable lower-level components, or is this a joint responsibility - and, if so, how do these professionals collaborate on this task effectively? Of specific concern are the pedagogical implications of successful technical convergence (e.g., the use of database-driven content systems, or the adoption of XML as a markup language): does this form of standardization support research on and development of pedagogical strategy, or does it sacrifice flexibility at this level to achieve the goal of technical convergence? The absence of a clear articulation of the interface between pedagogy and technology in practical terms may prove problematic.

2. Common architectural issues in the design of computer-based learning systems using modular content

To begin assessing the viability of current content development process models in the context of large-scale distributed learning environments, we can examine common categories of design decisions that occur in smaller-scale development projects and assess the possible ramifications of a significant change in scale on them:

- Modularity: What is a module, in terms of instructional content? What are the quality criteria for the definition of 'good' modules? Do these criteria change as scale increases? How do we use partitions between modules to manage risk in content development? For example, how do we partition a system in order to increase our ability to test numerous content components as they are being developed?
- Communication and information flow: What types of information get communicated between modules in a single system? Where are the architectural boundaries in an open content system? How does the information flow in a learning environment instantiate a pedagogical theory of control?
- Object- and component-based approaches to the development of instructional materials: How do we determine the right grain sizes for content development? What is the relationship between grain sizes for authoring and the units of analysis employed during front-end analysis? How can the choice of content units facilitate collaboration with software developers during design and production?
- Reusability: How is the design of a single reusable content component different from the design of an instructional product out of reusable components? What parts of a learning environment can be reused? How do we move from ad-hoc, opportunistic reuse to systematic re-use? What are the tradeoffs involved? Can there be too much reuse?
- Interoperability: At what levels is it feasible to make content interoperable? What goals are achieved by making content interoperable? What is the relationship between reusability and interoperability?
- System maintenance and evolution: How do we design system architecture so that it can survive, and indeed facilitate, bottom-up evolution of the system? What kind of evaluation data should the system collect, and how? How do we document system architecture so that it is understandable by those who will be responsible for its maintenance and evolution?
- Coordination: What happens when we move from managing individual content development projects in relative isolation to managing integrated content development programs? Which design assumptions are challenged when discrete learning products become parts of continuous learning systems?

3. The identification and categorization of design decisions

When a design domain is relatively stable, the explicit articulation of design decisions is less important, since decisions and their consequences are reasonably predictable based on past experience. Process-level issues can generally be resolved on a case-by-case basis in such circumstances. As the transition is made to developing instructional content components for use in distributed learning systems, instructional designers may face a period of domain instability where novel and complex interactions force many tradeoffs to be made unwittingly. Reassessing and evolving processes in light of these challenges will require an understanding of the new design space that instructional content developers are working within. In part, the opportunities and constraints associated with this new context will have to emerge through hard experience. A viable approach for articulating the boundaries and substance of this space in advance, however, is to identify and categorize the macro- and micro-decisions that are made in developing small-scale modular content, and examine these decisions in terms of their scalability to larger, more integrated systems. This is the subject of my current work-in-progress. By examining the development process from the perspective of decisions that are made during design, a top-down, principle-based approach to learning system architecture can be combined with a bottom-up awareness of the individual decisions designers make on actual projects. This is a key stepping-stone in the analysis of the cohesiveness and comprehensiveness of a given set of instructional development processes. The design decisions can also serve to frame, in tangible terms, the relationship between a given pedagogical strategy and its technical implementation.

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Interactive Flows in Language Learning on the Internet

Heloisa Collins
Catholic University of Sao Paulo – PUC-SP, Post-Graduate Program in Applied Linguistics - LAEL
Rua Bocaina 24/12 - 05013-030 Sao Paulo, SP, Brazil
hcollins@uol.com.br
www.hcollins.f2s.com

Abstract: Concerned with the relationship between interaction and learning, this paper aims at exploring relations between interactive flows in an EFL course offered on the Internet and language learning. The course was produced and is run by the research team of EDULANG, an ongoing research project in language learning on the Web and teacher development for the Web. In this research context, interactive flows are being used to record and analyze the rate and type of interaction in the course, identify units, tasks and course spaces that do not promote expected levels of interaction and plan and promote improvement in course structure, course content and teaching strategies.

Aims and Context

This paper derives from ongoing research in the context of EDULANG, a team project that aims at investigating multiple aspects of language learning and teaching in courses on the Internet. The paper is more specifically concerned with the relationship between interaction and learning and aims at exploring relations between interactive flows and language learning. An interactive flow is here defined as a longitudinal profile depicting amount (no. of messages or interactive turns) and direction (sender and recipient) of synchronous and/or asynchronous participation in an online course. The context of the research is an EFL course offered on the Internet (www.cogeae.uol.com/sal). The course was produced and is run by the research team of EDULANG. Aimed at adults with a basic command of English, its general social aim is to offer students the opportunity to make new acquaintances on the Internet. This general aim unfolds into specific social and language-specific, communicative functions. The course officially lasts 8 weeks but can in fact reach 12 to 13 weeks. The interactive spaces make it possible for participants to a) communicate through messages posted to a virtual Bulletin Board (BB) subdivided into three forums (Classroom, Café and Technical Support), b) display (and re-edit) their interactive production to course peers in a Production Panel, c) send progress tasks and tutorial exercises to the teacher through mail-to devices on the course pages and d) participate in online Chats. All communication is carried on in English, except for messages left in the Technical Support forum. As an essential element of learning and knowledge construction, interaction must be evaluated for type, effect and efficiency in courses on the Internet. In this research context, interactive flows are being used to record and analyse the rate and type of interaction in the course, identify units, tasks and course spaces that do not promote expected levels of interaction and plan and promote improvement in course structure, course content and teaching strategies.

Method

Data was collected from indicators about sender, recipient, date and subject of 6 groups of students and their respective teachers, in 1998 and 1999, and include a) messages posted in the Bulletin Board, b) messages with ongoing tasks sent to the teacher, c) texts displayed in the Production Panel and d) participation in online chat sessions. All indicators were available within the course system.

Some Findings

Results were organized in order to reveal graphic flows of interaction involving students and peers, students and teacher, teacher and students. These flows reveal trends within each group as well as across groups. Interpreted in the light of the course context, the graphic flows below have offered support for pedagogical and managerial decisions, as well as for changes in design. Figure 1 indicates that in this course, the amount of student talk tends to be equivalent to or higher than teacher talk. This may mean that in an interactive internet course, students engage in more interaction than students in traditional face-to-face EFL courses. Figure 2 shows that different groups present different types of flows, either with a focus on teacher-student and student-teacher interaction or with a focus on communication among students. In groups where the teacher talks less, interaction among students tends to be higher. In this sense, the amount of teacher interaction with students influences the amount of students' interaction with their peers. Additionally, Figure 2 shows that groups A, B, C and D (taught in 1998) communicate a lot less in the BB than groups C and D (taught in 1999). This suggests a development of familiarity and comfort with educational contexts on the Web for both students and teachers. However, relatively close averages of participation in the 1998 groups (11.07, 5.53, 8.45 and 11.95) and equivalent participation in the 1999 groups (28.28 and 28.38), suggest that students seem to have a *quantitative communicative quota*, that they strive to use, regardless of the interlocutors they choose to have (the teacher or a peer). Figure 3 allows an interpretation of the interactive flows in the BB in the light of course content distribution (weeks 1-3 for unit 1, weeks 4-5 for unit 2 and weeks 6-8 for unit 3). A higher state of motivation seems to be associated to specific phases of the course when participants are all getting to know each other (the beginning) or students are trying to close their participation successfully (the official end, the 8th week). Mid course activities have not been able to sustain adequate levels of interaction (notice the relative drop both in the 98 and 99 groups) and are now being thoroughly reformulated. Figures 4 and 5 offer data for interesting observations. Groups A and B seem to reinforce the *quantitative communicative quota* hypothesis, with task completion and BB message flows in a complementary relationship (lower averages in one flow type complement higher averages in the other). Groups C and D, on the other hand, present opposite results in both types of flows and suggest that teacher management has a big influence on task completion and student participation in the BB. Figure 6 reveals that among students who completed at least 50% of tasks there are more poor "chatters" (23) than good "chatters" (13). However, among the best "chatters" (more than 30 turns) were the best task completion rates. This suggests that completing tasks (a traditional activity) is still favored over other web-typical types of participation and that an intensive participation in chat sessions is usually associated to intensive task completion.

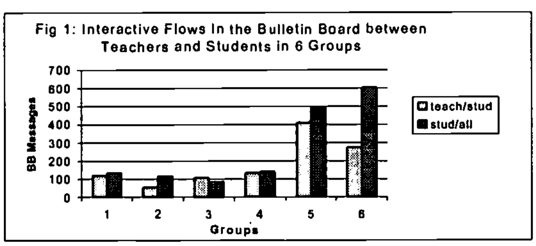

Figure 1: BB Messages between Teachers and Students

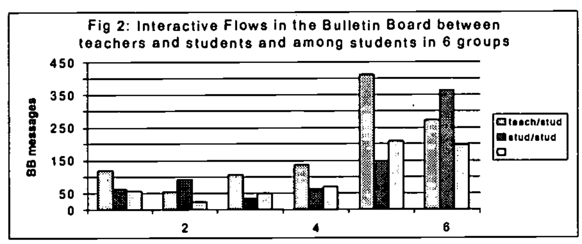

Figure 2: BB – teachers/students and student/student

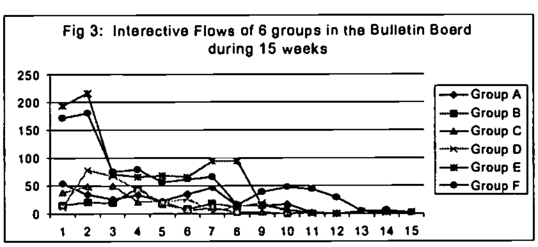

Figure 3: Flows of 6 groups in the BB during 15 weeks

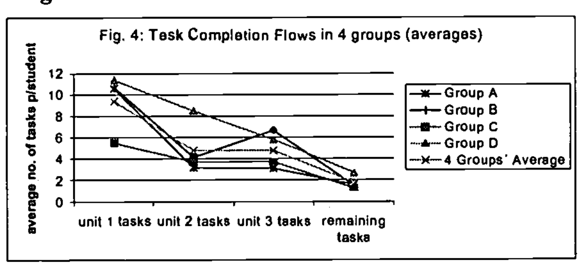

Figure 4: Task Completion Flows in 4 groups (averages)

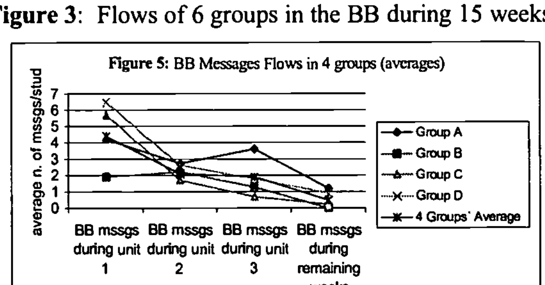

Figure 5: BB Messages Flows in 4 groups (averages)

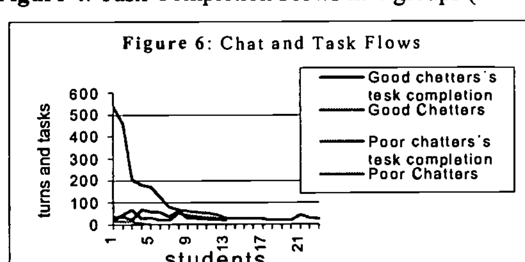

Figure 6: Chat and Task Flows

The effects of collaborative, online learning on broadcast journalism students: Perception and understanding of undergraduates at linked universities worldwide.

Marion Coomey
International Centre for Learner Managed learning
Middlesex University
United Kingdom
m.coomey@mdx.ac.uk
marioncoomey@hotmail.com

Abstract: This paper describes a study that is being developed to explore online collaboration between undergraduate journalism students at universities in Australia, Canada, New Zealand, the United Kingdom and the United States. The premise of the study is that by bringing students, instructors and experts together to examine different perspectives of international news stories, learners will develop a stronger understanding of stories that get international coverage. The goal of the research is to develop a consensual and collaborative module that explores international perspectives on global news and to present this module, online ,to teams of students at the partner universities. Data will be gathered from online interviews and questionnaires given before and after the module.

Introduction

In the past decade there has been a growing amount of research in journals, books and conference papers in the area of online learning. Online learning, for the purpose of this research, refers to study that is done using computer technologies with the learner at the same location or at a distance from the instructor.

Many established universities, such as Stanford in the United States, Deakin in Australia, University of Twente in the Netherlands, offer online classes to students who live at a distance from campus, to learners studying part-time and to professionals engaged in life long learning. These classes may have an international reach but are run and controlled entirely by individual universities. The Open University in the United Kingdom and the University of Phoenix in the United States are two examples of universities that are completely online. All students study from a distance but students are still studying at one university and working within the structure and policies of that system.

Most of the online classes described above, involve students working alone online with some support from instructors or tutors via e-mail but with little collaboration amongst students themselves. Collaborative learning, as defined for this study is: learning in an educational program created by a group of partner universities and in which students and instructors get together to examine course content issues. This sort of interactive, online learning is becoming more widely practised. Medical schools throughout Germany (Friedl, 99) share online resources to study cardiac surgery. An online training for trainers course involved learners in 22 European countries (Leino, 99). Organizations such as the United Nations are using online modules to give professionals around the world a chance to study copyright law (Durant, 99).

So far, in this researcher's literature search, most examples of online collaboration involve engineering, science, medical and business programs and most of the collaborations are developed at one university. Telg (96) noted that in the United States "few collaborative distance education efforts have taken place between American universities and universities in other countries".

In this researcher's area of interest, broadcast journalism, there is little documentation in the literature of any programs using online collaboration as a learning tool.

Study

It is becoming easier and easier for journalists to quickly gather information from any part of the world and disseminate it to any other part of the world but McGregor (98) asks is "the news is better reported with more understanding as a result of the new technologies". We are sending young broadcasters into a world of instant information, instant analysis and instant conclusions about global news issues. One of the questions raised by this study is: do those young journalists, and the experienced story tellers for that matter, have the enough understanding of global issues to provide clear, non-biased reports?

The premise of this study is that by linking students, instructors and broadcast experts in online discussion and by working in international teams on assignments and presentations concerning global news, the learners will develop a stronger understanding about stories that gain international media attention. The researcher is working in consensus with partner instructors in Australia, Canada, New Zealand, the United Kingdom and the United States to develop a collaborative module that will allow students to examine and discuss international perspectives on global news stories. Students will gather at the module web site that includes: structured and unstructured forums for discussion and debate, a location for students, instructors and industry professionals to interact, links to broadcast networks worldwide plus visual and written content that takes the learner through the module and its assignments step by step.

Data will be gathered using a quiz to examine students' knowledge of global news issues, before and after the module is run. Learners and instructors will respond to questionnaires online before and after the module and will participate in structured and informal taped interviews to elicit personal and anecdotal information. At least ten students from each partner university will participate in the first run of the module in April 2001.

The result of this study will be to establish an international circle bringing learners with different backgrounds and understandings of international news, into an ongoing discussion. The timing is right to examine how online collaborative learning functions within the untested area of broadcast journalism and to determine if there is a benefit for students in using this new teaching/learning method. This study aims to bring issues of online learner effectiveness to light to provoke further discussion research and practise in this area.

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CHANGES IN CANADIAN HIGHER EDUCATION ICT AND SUPPORT, 2000 TO 2003

Carl Cuneo, McMaster University and EvNet, Canada (cuneo@mcmaster.ca)
Brain Campbell, Mount Allison University and EvNet, Canada (bcampbell@mta.ca)
Campus Computing International (Canada)

Over the next decade, there will be an increasing digital gap between higher education institutions offering and not offering online courses. This will result from the lack of planning by offline institutions in information technology policies, networking and technical infrastructure, and access to remote electronic library resources. This is not an all or nothing situation. Some offline institutions have laid plans for a digital learning future. But compared to online institutions, they have less extensive plans. It takes several years of laying down the technical infrastructure before we see the results in suites of online courses. An institution cannot decide one year to start putting in place such an infrastructure, and then expect to see the results the following year in a dramatically increased online learning.

We mailed 8 questionnaires to 310 colleges, CGEPS, and universities in English and French Canada. 134 institutions returned at least one questionnaire from June, 1999 to April, 2000, for a response rate of 43%. The response rate was good among the 60 universities (89%), but poorer among colleges (35%) and CGEPS (25%). This is due to the inclusion of many very small colleges and CGEPS that had difficulty filling out complex questionnaires. The questionnaires were completed by 8 senior officials responsible for policy and implementation of information, communication, and learning technologies (questionnaires returned are in parentheses): VP or most senior officer responsible for information and communication technology policy (82/134 =61%); manager or director of networking and technical infrastructure (72/134 = 54%); head of computer support (84/134 = 62%); director of audio-visual services (68/134 = 51%); head librarian (68/134 = 51%); head registrar (69/134 = 52%); director of instructional development or academic or teaching technologies center (75/134 = 56%); and, president of the faculty or teachers' association (47/134 = 35%). The following comments and analyses are based on these data.

INFORMATION TECHNOLOGY POLICIES

VPs of Information Technologies at institutions offering online courses, compared to those not offering online courses, placed more emphasis over the next 3 years in: instructor training in teaching technologies; recruitment of more technical staff; cooperation with other institutions in software licensing; encouragement or requirement of student computer ownership, and provision of open access computers to students. If we expect the information technology gap to close between online and offline institutions, institutions not offering online learning should emphasize these policies at least to the same degree, if not more, than institutions offering online courses. But this is not so. Over the long term this will lead to a growing gap between online and offline institutions.

NETWORKING AND TECHNICAL INFRASTRUCTURE

We asked Managers of Networking and Technical Infrastructure how much they emphasize servers, networking, student computers, and wireless devices in their plans. The data on servers reflects the declining use of UNIX (despite its history and stability), and the rise of Linux and Microsoft NT servers. But institutions offering online courses are more likely to have all three server types in their plans than institutions not offering online courses. This may reflect the greater demand on servers among institutions that offer online learning. However, online courses are not the only demand for servers; they are used for a wide variety of administrative and educational functions. Our question did not tie the server type to a particular online learning use. The data probably reflect a more general difference in information technology configurations between online and offline institutions. Online institutions are also much more likely to expand wired and wireless networking, fast ethnernet connections, notebook and other mobile computing devices, and student computer lab capacity. The differences are so large that this kind of weak infrastructure in offline institutions will likely undermine their inability to offer future online learning.

DIGITAL LIBRARY RESOURCES

If institutions not offering online courses expect to catch up to institutions offering online courses, they should reduce their expenditures on hard copy print library resources as much as or more than institutions that are heavily into online learning. In fact, that is not the case. Offline higher education institutions plan to spend more on hard copy print library resources. A greater percentage of head librarians of institutions offering online courses plan to expand electronic library resources over the next three years in contrast to offline institutions. This reinforces the view that institutions already offering online learning are forging ahead with additional plans to develop and extend their information technology infrastructure, in this case the library infrastructure, in contrast to institutions not offering online learning. Our data also suggest that most libraries are moving quickly into the electronic age on almost any information technology question we asked. But only about one-third of head librarians plan to emphasize student e-mail access over the next three years. Libraries do not view themselves as centers for providing students with e-mail access; such services and access are available elsewhere on campus and from off-campus.

SUPPORT FOR ELECTRONIC COURSEWARE

Directors of Academic Technology and Instructional Development Centers at institutions offering online courses plan to emphasize the following between 2000 to 2003 in contrast to institutions not offering online courses: funding for teaching support and teaching technology support units; funding for free instructor workshops in academic technologies; training instructors in computer literacy and web design; funding for instructional technology projects proposed by instructors, academic programs, and departments; web course outlines; interactive multimedia web courseware with full instructor participation to teach the courses; standalone interactive web courseware with minimal instructor intervention; e-mail in courses; computer conferencing in courses; and, computer-supported collaborative learning (CSCL) in courses. However, those items receiving the greatest endorsement over the next three years among institutions offering online courses are: course outlines on the web; computer conferencing in courses; computer supported collaborative learning in courses; and, training instructors in web design. The least emphasis in plans over the next three years are in user-pay instructor workshops in academic technologies, and funding for instructor release time to work on teaching technologies.

REGISTRAR PLANS FOR SUPPORTING ONLINE LEARNING

Among head registrars at Canadian higher education institutions, there is a moderately positive association between the number of online courses offered and plans over the next three years in: student web registration; electronic delivery of student academic counseling; web course evaluations and course outlines; courses geared to job skills; distance education courses; computer conferencing, video-conferencing and e-mail in courses; computer-based training; and, linking electronic classrooms between institutions. There are no plans among registrars in institutions with many online courses to move into general paperless office procedures and web calendars over print versions (already done); student computer competencies (these skills are assumed or picked up as students take online courses); instructor online access to class lists and online submission of student grades; and, information technology in face-to-face courses . There are three areas in which registrars with low numbers of online courses plan to emphasize over the next three years, while registrars at institutions with many online courses will definitely not emphasize: part-time student enrollment; continuing education; and, instructor access to student academic records. It is often assumed that distance online learning goes hand-in-hand with continuing education and part-time studies. This may have been the world of traditional distance education. Online learning has moved out of continuing and part-time studies into full-time studies. We are probably witnessing here a transition in the academic programming of distance education as it moves from offline print correspondence to online learning.

DEVELOPMENT AND DELIVERY TOOLS OVER NEXT THREE YEARS

We asked directors of Instructional Development and Teaching Technology Centers the emphasis that their institutions will place on development and delivery software over the next three years. Institutions offering online courses indicate that they will move more strongly in the direction of the top software in the market. Over three quarters (78%) of institutions offering online courses indicated that they will move even more strongly in the adoption and implementation of courses using Web CT. Even among institutions not offering online courses, almost one-third (30%) plan to adopt WebCT. No other software comes close to WebCT in the future plans of institutions. However, there is significant growth potential in Lotus Notes, Centrinity's FirstClass, Macromedia Director and Authorware, Asymmetrix's Toolbook, and the Web Board. There does not seem to be much growth potential in Virtual-U, Question Mark, Allaire Forum, Norton Connect, and Web Course in a Box.

CONCLUSION

There is little evidence to suggest that institutions not offering online courses will soon catch up to institutions currently offering online learning. They have not prepared their technical infrastructure for offering online courses. Their main hope might be closer collaboration with neighboring institutions that have prepared their own infrastructure for a digital future in online learning.

ACKNOWLEDGEMENT:

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SUPPORTING A COMMUNITY OF PRACTICE: THE ROLE OF WORKERS AS LEARNERS

Maarten de Laat, Frank de Jong and Julian ter Huurne
University of Nijmegen and the Education and Knowledge Center (LSOP) of the Dutch Police
m.delaat@ped.kun.nl

Abstract: In this paper we focus on the use of computer supported collaborative learning (CSCL) in an organizational setting. The program we use is Web-Knowledge Forum. Although there is a lot of experience in using Knowledge Forum in a classroom setting, little is known about how to implement and work with this program in an organization other than schools. The problem investigated in this pilot study is how a community of practice uses Web-Knowledge Forum as an online learning environment to discuss work-related problems. This study focuses on role of the worker as a learner in an unstructured process of negotiation of meaning in a community of practice. In the study eight police officers participated by forming a heterogeneous group initiated by the Information Management Approach of Criminal Investigation in Police Education (ABRIO) a subdivision of the Dutch police force.

Introduction

A learning organization stimulates the ability to learn individually, in groups and to learn by the organization as a whole. The aim in this is to support continuous learning to combine and develop knowledge in the organization in order to respond flexible to changes that occur in the market (Bolhuis and Simons, 1999). There is a tendency to organize this learning as close to the workplace as possible instead of sending people to courses given outside the workplace (Van der Krogt, 1995; Nonaka & Takeuchi, 1997; Bolhuis & Simons, 1999). Revans argued for action learning. He formed learning teams to work on real organizational problems and to structure their experience in such a way that both useful solutions to these problems emerge and substantial learning occurs for participants (Vaill, 1996). So the employees are recognized as an important resource to the organization. According to Wenger (1999) people in organizations form communities of practice by helping out each other and discussing the latest developments. These communities of practice are bound by a shared practice related to a set of problems. In these communities they share and create knowledge; they learn through participation (Wenger, 1998). Membership to these communities of practice is voluntary, these communities are not bound by organizational affiliations.

In large organizations like the Dutch police force online communities have an advantage in bringing people together independent of time, space and local cultures. CSCL makes it possible for people to participate in communities of practice and work at their own pace and time. One of the programs that support this kind of collaboration is Web-Knowledge Forum. Web-Knowledge Forum is a discussion program designed to form a learning community over the Internet. It's a product of the Computer Supported Intentional Learning Environments (CSILE) family, developed at the Ontario Institute for Studies in Education (OISE) to support the collaborative construction of knowledge (Scardamalia & Bereiter, 1992). The participants operate in a shared workspace in which they read and write notes. A note is a contribution that can contain text, pictures and links to documents, html pages or other notes in the shared knowledge workspace. Working with this program stimulates the participants to talk about the subject, read relevant resource materials, pose questions, offer theories, conduct experiments, and work together to make sense of new ideas. By working together participants develop greater competence in a particular subject area, using what group members already know as an important component and co-constructing plans of action to extend that knowledge (Hewitt & Scardamalia, 1998). The creation of knowledge therefore is seen as a social product.

Originally this program was designed for use in the classroom to support the construction of knowledge in a social context. The aim in the development was to support an environment that will make it possible for schools to function as knowledge building communities (Scardamalia & Bereiter, 1992). Within knowledge building communities the focus is on knowledge construction. It's a knowledge-centered community of practice.

The problem we face is how to facilitate the creation and support of communities of practice in organizations that work in a Web based environment and make knowledge building the core of their activity. In the first place there has to be identified a 'real' and meaningful problem that exists in the organization. A problem that is owned by the participants and in which solution they are willing to put effort. Second the members of the organization who feel affiliated by this problem have to form a community in which they can participate on a voluntary and functional basis. In this paper we focus on the possibilities of Web-Knowledge

Forum to serve as a meeting place for such communities. A place where participants can work together, undertake collaborative learning activities, sharing their knowledge, aimed at deepening their expertise in the problem to be solved.

Our question is: Can groupware, e.g. Web-Knowledge Forum, support the negotiation of knowledge and understanding in communities of practice in an organization?

We focus on the role of the worker as a learner in an unstructured process of negotiation of meaning in an online community of practice.

The study

This study was conducted to gain experience with participants who were engaged in an online learning community. The community consisted of eight participants who voluntary joined in the community. They responded to a letter that was sent by the ABRIO to several police departments explaining the problem that has to be solved. The problem was about how to identify and describe general work-processes used in the field of criminal investigation. As a whole the participants formed a heterogeneous group (policy makers, criminal investigators and experts).

During a period of two months they worked together using Web-Knowledge Forum. There was much uncertainty about how to identify work-processes, therefore the participants agreed to start with an open discussion on the subject 'work-processes', instead of following a structured plan of action to tackle the problem. Web-Knowledge Forum played a central role in supporting the discussion because all the written contributions are stored as notes in a shared database available to all the participants. The discussion was divided into certain subjects called views in which the participants contributed a note or comment on a note they had read, by writing a build-on note.

Instruments

The way people participated and interacted with each other provides information about the activities of such a community. Web-Knowledge Forum is provided with an analytic toolkit (ATK) that analyses the activities of the members of the community in the database. It creates log files of all the users about how many times they have read, write or edited a note. How many notes are linked to each other and how many 'build-on's there are made.

Web-Knowledge Forum is designed to facilitate cognitive and metacognitive activities by providing opportunities to give your opinion, to give a comment, or by making suggestions or providing new information. Because of these possibilities it is important to know more about the nature of the content of the material the community has created together and what kind of activities the participant undertake. Are they trying to advance their knowledge? Veldhuis-Diermanse (1999) developed a coding scheme to gain information about the content of the written notes based on the constructivist view of learning in an educational setting. This coding scheme is still in a design stage and it is the first time this scheme is applied to an organizational community. This coding scheme consists of three main categories: 1 Cognitive activities, 2 Metacognitive activities, and 3 Affective activities.

1 Cognitive activity: Cognitive activities are used to process and acquire insight in the information being discussed. Veldhuis-Diermanse recognized three subcategories of cognitive activities: 1 debating, the accent is on arguing, presenting new ideas or thoughts about the subject; 2 using external information, the accent is on referring to information found in other sources than the database; and 3 linking or repeating internal information, the accent is on referring to information found in the shared database.

2 Metacognitive activities: Veldhuis-Diermanse (1999) describes metacognitive activities as activities undertaken to regulate each other's learning process or to regulate the goals and direction of the discussion.

3 Affective activities are used to cope with feelings occurring during the discussion among the participants (Veldhuis-Diermanse, 1999).

At the end of the pilot-study we gave the participants a questionnaire to gain information about their experiences working with Knowledge Forum.

Results

The log files generated by ATK gives a description of the activities that has taken place in the database (Tab. 1). The participants contributed 98 notes in the database. That's an average of 12,25 notes per participant. 56% percent of the notes have been read. This means the amount of notes that have been opened by the participants. So this might exaggerate the actual reading that has been done. 83% percent of these notes are linked, also called build-on. The log-file only records the activities of the participants, a build-on activity therefore does not have to be content related. Table 1 shows that there are substantial differences between the participants, both in writing and reading. Notice that build-on notes are also a part of the written notes.

	Written	Build-on	Read
N	8	8	8
N	8	8	8
Mean	12,25	10,75	232,62
Mean	12,25	10,75	232,62
Std. Deviation	9,54	8,80	147,51
Std. Deviation	9,54	8,80	147,51
Minimum	1,00	1,00	113,00
Minimum	1,00	1,00	113,00
Maximum	30,00	26,00	552,00
Maximum	30,00	26,00	552,00

Table 1. Participation in the database

The content analysis of the notes reflects the following cognitive and metacognitive activities (Fig. 1).

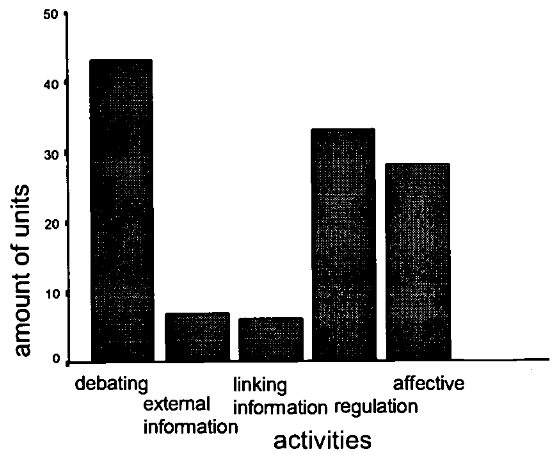

Figure1. Activities in the database

These results indicate that the participants discuss a lot about the subject. The participants present a lot of ideas of there own and start discussing about that in the community. The participants do not bring in much new information; only seven times they referred to information that can be found outside the database (e.g. book pages). Also they did not make many content related references to the contributions of other participants in the database. Although according to the ATK 83 % of the notes are linked. This difference is explained by the fact that the coding scheme only refers to written comments to other contributions in the database. The participants show quite a lot of regulative activities, but in fact two participants are responsible for 66% of the regulative activities. There are quite a lot of affective contributions in the database. The explanation for it is that this way of working was new to them and therefore they were regularly asking for feedback and gave a lot of general reactions to the other participants. This category shows that they did not use this medium for chatting or sending 'e-mails' to each other, that are not related to the discussion. Most contributions even the affective ones were subject related.

The questionnaire provided information about the way participants worked with Web-Knowledge Forum, five out of eight were returned. 60% of the participants agreed on the question if they were collaboratively building new knowledge about 'work-processes', but they pointed out that they need to grow more into building upon the ideas of others. Also they mentioned that there was a lot of confusion about the concepts being used and that they need to clarify the goal of their study, to give more direction to the discussion. 80% of the participants indicated that they were satisfied with the opportunities, provided by the program, to discuss the subject together. The participants (80%) notified to have enough information to be able to take part in the discussion. Answers to the question, what they do if they lack certain information, are searching for relevant information, consulting colleagues at work, and trying to stimulate the other participants to explain certain issues. Results of the question about what they thought of the quality of the written notes, varies from good to reasonable. In general the quality is good but the discussion became more silent later on. "There is to little structure to guide our discussion, the notes contain valuable information but what does it bring to us?" 40% of the participants indicated that there was to less coordination during the discussion. 60% of the participants pointed out that a more structured or goal directed approach is necessary. They argue that this will help them to achieve agreement and build on to that.

Conclusion and Discussion

Summarizing the results it can be seen that the participants show a lot of activity in the database although they read much more than they contribute. Related to the content analysis of the contributions. It seems that the activities the participants undertook are more discussion oriented than building knowledge upon already contributed or new information. However in their perception of working with groupware they appreciate the possibility of knowledge sharing. On the first glance people are willing to work in a groupware environment and share knowledge together. This is promising for the support of working in communities of practice in organizations. The analysis also shows that sharing of knowledge does not happen automatically. Although there are a lot of regulation activities, it turns out that they were mostly carried out by two participants. The questionnaire reveals that the community members desire more structure and support to direct the knowledge building activities of the community as a whole. The use of groupware in communities of practice in organizations seems promising. The participants report that this tool is useful for knowledge sharing but that the actual knowledge building activities needs to increase. They had trouble clarifying the goals and direction of the discussion. Also they discovered that there was quite a lot of confusion about the concepts used by the participants. The main concern was lack of coordination during the discussion. In an unstructured process of negotiation nobody feels direct responsibility to organize and structure the content of the problem studied. The lack of the learning ability in the sense of regulating the content and community processes seems to be crucial for people to become used to share knowledge, deepening their own and common understanding and creating further insights. To compensate this lack one can structure the negotiation of meaning by making a learning agenda. By which participant express their goals, divide certain tasks, and divide responsibilities (e.g. coordinator of the content, someone who keeps the community together or invites new participants when needed, technical assistance). One can also introduce a didactic approach of inquiry analogue to phases of the scientific enquiry process or problem solving.

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Web Accessibility Overview: What's What? Who's Who? How to?

Deanie French, Ph. D
Southwest Texas State University
601 University Drive
San Marcos Texas
elearn@Deanie.org

Abstract: Federal mandates enacted on August 7, 1998 revealed that "Effective 2 years after the date of enactment...any individual with a disability may file a complaint alleging that a Federal department or agency fails to comply with subsection (a)(1) in providing electronic and information technology. (Section 508. "Electronic and Information Technology) "The new rules will apply within a few months to all web sites operated by government agencies...By August 7, 2000, they will extend to vendors doing business with the federal government. "Possibility soon afterward they may extend to every Web site posted in the U.S." (Adam Clayton Powell III). Are ready for August 7, 2000? If not, this paper can provide ideas to help you get started.

Introduction

In PC Week Online, Vaas (2000) notes that between 95 and 99 percent of web sites are inaccessible to the visually, hearing -and/or mobility impaired. Many web developers are ignoring the accessibility issue or just do not know how to making their sites universally accessible. They are bewildered in the face of the vast information available in terms of how to make it applicable to their situation. Three areas can help focus the journey to understanding.

What's What

The law is the driving force behind the need to have universal web sites. There are already been law suits against AOL and Universities for not providing accessible web access. Equally access to information is the key reason that the focus is on web sites. Individuals cannot fully participate in today's complex society based on technology-based information if they do have access to the same information. There are several references to the law at the following web site:
http://www.swt.edu/~df12/summit/LAW.HTM

Who's Who?

This paper will mention just a few of the leaders in the field who are trying to make electronic information globally accessible. **The first is W3C.** Their mission states "The W3C's commitment to lead the Web to its full potential includes promoting a high degree of usability for people with disabilities. The Web Accessibility Initiative (WAI), in coordination with organizations around the world, is pursuing accessibility of the Web through five primary areas of work: technology, guidelines, tools, education & outreach, and research & development."
(http://www.w3.org/WAI/) W3C focus is for experienced programmers and guidelines can be found at the following address:

http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/

Accessible Web Authoring Resources and Education **(AWARE)**, mission is to serve as a central resource for web authors for learning about web accessibility. The AWARE Center was launched in April 1999 as part of the HTML Writers Guild's (HWG) annual Web Accessibility Month, a special focus on the importance of designing for universal accessibility. The Center is supported by the Guild's staff and volunteers, and is designed as a resource for all web authors. Ken Barlett co-founded the HTML Writer's Guild with Martin Bayne. The HWG is the world's largest international organization of Web authors with over 130,000 members in more than 130 nations worldwide. The HGW exists to assist its members in developing and enhancing their capabilities as web authors, to compile and publicize information about standards, practices, techniques, competency, and ethics as applied to web authoring, and to contribute to the development of the web and web technical standards and guidelines.

Disability Access Information and Support **(DAIS).** Jane Jarrows, President, states, " But after we got the ramps and elevators installed, we could think about how to make the teaching that had always gone on in those classrooms fully available to all students. The parallel ends here. While we are scrambling to get the technological "ramps and elevators" in place, we are actively creating new barriers to access on a regular basis. At the risk of stretching the analogy a little too thin, if we don't be careful we will find that when those technological ramps and elevators we installed are finally in place, they only allow for a better view of the opportunities passing by us. We cannot wait to get the technology in place before we start trying to impact on the application of that technology

Microsoft. The Microsoft Senior Initiative is a program aimed at bridging the digital and generational divides and ensuring that seniors are not left behind on the information superhighway. By providing access to information technology and PC literacy training, the Microsoft Senior Initiative introduces the exciting possibilities of technology to senior citizens. The Seniors and Technology Web site (http://www.microsoft.com/seniors/) is a resource for seniors, their families and communities about the exciting possibilities that can be realized through the use of technology.

How to? For people who are just learning how to develop web pages, the easiest way is make a page using a "what you see, what you get editor," then save the web page as text and htm. The problem with this method is that that many people do not do an adequate job of keeping both pages updated. Software companies are starting to make it easier to make web pages accessible through what is called, style sheets, which control the presentation of a document. It is often easier to work in pairs or teems of two to learn this process. There are often many free workshops on the web and in your local area. Perhaps partner with someone who can pay to have a consultant.

Design is the first part of "how to." The second part is getting your page validated by a reliable source. Sites can be easily validated using on-line features which require that you paste your URL name in the box and almost immediately you will learn if you have accessibility problems. The top two sources of validation are:
Bobby Accessibility Validator
http://www.cast.org/bobby/

W3C HTML 4.0 Validator
http://validator.w3.org/

The complexity of implementation of this mandate can not be fully address with this in progress paper; however, there will a much greater discourse at the Universal Web Accessibility Symposium 2000 (at WebNet 2000) -- San Antonio, Texas, October 31, 2000.

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Suffering Remotely:
Challenges When Teaching On-Line

Stuart Young
Department of Information Systems and Computing,
UNITEC Institute of Technology,
Auckland, New Zealand
+64 9 415 4321 ex 8656
syoung@unitec.ac.nz

Mae McSporran
Department of Information Systems and Computing,
UNITEC Institute of Technology,
Auckland, New Zealand
+64 9 415 4321 ex 8658
mmcsporran@unitec.ac.nz

Ross Dewstow
Department of Information Systems and Computing,
UNITEC Institute of Technology,
Auckland, New Zealand
+64 9 415 4321 ex 8654
rdewstow@unitec.ac.nz

Introduction

Many educators are experimenting with flexible on-line learning; consequently academics have to adapt their delivery, preparation and course administration. This study shares staff and student experiences of participating in a completely remote on-line course, compared to a flexible on-line course where students can attend classroom sessions.

The issues we encountered included ones related to hardware and software, submission of assessments, student communication with each other and the lecturers, as well as student and staff motivation over the holidays.

Existing research documents the pitfalls of teaching on-line and we used these lessons to anticipate problems as we planned our on-line course. This study documents the problems we encountered but hadn't anticipated.

THE COURSE

Internet and Web Design (IWD) is a popular first year introductory course in the Bachelor of Computing Systems degree. It is normally taught flexibly with lectures and practical classes as well as a self-paced on-line course comprised of notes, exercises, self-assessment questions and a discussion forum (1). In the 1999-2000 Summer School, the course was offered completely remotely and condensed from 14 to 11 weeks. There were no face-to-face sessions except an orientation session, the project presentations and final exam. If students had problems they were requested to post their question on a discussion forum and had no option to ask the lecturers face-to-face.

DISCUSSION

Student issues

No time for a Summer break, condensed time frame, lack of personal tutor-student contact, no option of attending classroom sessions for personal contact with other students and no opportunity to take on a vacation job. Perhaps because of the above issues, there was a higher level of drop outs than normal. Reasons for students dropping out included: getting a job, workload too heavy and no computer access at home

Staff issues

Lack of a gap between semesters to attend to the course administration for the previous course. We undertook the course as an extra to our workload, meaning no summer break to recharge and prepare for the next semester. Most of the workload consisted of administration and marking and we felt the remuneration we received did not reflect the associated workload.

Bulletin board issues

If students had problems they were requested to post their question on the discussion forum rather than e-mail the lecturers, (so that we could avoid duplication of lecturer responses and attempt to mirror classroom communication by allowing students to answer each others' questions when lecturers were not around). Despite our attempts to encourage participation, the use of the bulletin board was fairly low, with only 140 posts over the whole Summer School. Many students continued to email the lecturers rather than use the bulletin board for questions. Perhaps this was because they didn't want to look unknowledgeable in front of their peers, or because we didn't assess the students' contributions (2,3). Lecturers accessed the bulletin board every other day to check for questions to answer. The lecturer's often interrupted their vacations to make special trips to cyber-cafes, only to find that no students were seeking help.

Assignment submission issues

Students didn't email their assignments to the correct address, often sending them to our home email addresses and multiple addresses. Issues resulting from this included: lack of software at lecturer's home; lecturer's vulnerable to the risk of virus infection; and duplication of administration effort. There was a significant administrative burden for the lecturers who had to confirm receipt by email and print out the assignments. This was exacerbated by the often inappropriately large file sizes of the email attachments, (e.g. one Storyboard Word document was 3.5Mb).

Group work issues

Generally, students find it difficult to work in groups. This is exacerbated in an on-line course by having to use the printed word rather than face-to-face interaction. The condensed timescale of the course made this even more of an issue and one of our groups suffered a complete breakdown in communication. During a Semester course it is easier to identify problems with group dynamics and deal with them before they escalate.

CONCLUSIONS

The students had a generally favourable impression of on-line learning, but with reservations about the lack of personal contact and the high workload due to the collapsed course time-scale. Reasons for the course's success included: anticipating possible problems and devising strategies to deal with them; and the considerable amount of user-testing that took place in the prior flexible on-line versions of the course, when semantic problems could be cleared up easily.

However unexpected problems were: inter-group conflicts; a higher than normal drop-out rate that impacted on other group members; higher than normal administrative burden on the lecturers; and serious practical problems with the publishing of student web-sites using FTP (4).

It is important to spend time forming project groups, to let the students get to know each other's skill-set and interests thereby avoiding problems. This is perhaps even more important in a fully on-line course.

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Streaming Video: Pedagogy and Technology

Trevor Doerksen
University of Calgary
2500 University Dr. NW
Calgary, Alberta, Canada
doerksen@ucalgary.ca

Mike Mattson
University of Calgary
2500 University Dr. NW
Calgary, Alberta, Canada
mmattson@ucalgary.ca

Jack E. Morin
George Washington University
Washingtom, DC.
United States
morin@ucalgary.ca

Abstract: Offering video and other rich media content over the Internet is an emerging growth area and represents a new model and opportunity for education. As broadband access increases and advances are made in network caching, streaming servers, video and audio compression, and multimedia databases, delivering streaming video claims unprecedented potential for education. Universities and corporations will continue to look to technology to deliver distance education and web based courses. Determining the pedagogical applications of streaming video is an important area of research. Identifying the strengths and weaknesses from an educational point of view provides an important context to the practical matters of technical implementation. This research intends to investigate both the pedagogical implications and the technical implementation of streaming video.

Overview

Offering video and other rich media content over the Internet is an emerging growth area and represents a new model and opportunity for education. As broadband access increases and advances are made in network caching, streaming servers, video and audio compression, and multimedia databases, delivering streaming video claims unprecedented potential for education. Universities and corporations will continue to look to technology to deliver distance education and web based courses. Determining the pedagogical applications of streaming video is an important area of research. Identifying the strengths and weaknesses from an educational point of view provides an important context to the practical matters of technical implementation. This research intends to investigate both the pedagogical implications and the technical implementation of streaming video.

Often when new technologies, like video, are applied to education they are seen as having the ability to make us all learn better and faster. Some of the questions that need to be answered regarding pedagogy include:

- Does streaming video over the web offer any more promise than standard videotape, the Laser Disc, or the CD-ROM?
- Can the metadata applied to streaming video offer learning strategies and information that was previously unavailable?
- Does the distribution medium, the Internet and a computer, improve the quality or access to instruction?
- What are the ideal tools and methods to develop content and sufficient metadata that make streaming video effective in teaching and learning?

In addition to the pedagogical perspective, there is a highly technical aspect of streaming video that affects price, availability, usability, performance, and quality. The following technical components will be investigated:

- Copyright, Security, and Intellectual Property
- Multimedia Databases
- Servers
- Clients
- Compression
- Network Caching and Bandwidth Issues

Finally, partnerships with industry suppliers, distributors, faculty, and technology solutions will be investigated in an effort to provide business models that can recover the costs of implementing and delivering streaming video content for universities.

Currently, the pedagogical potential of streaming video has not been demonstrated, the technology is so new that it remains largely untested in a learning environment, and content development tools are crude or non-existent. Answering the various pedagogical and technical questions are important outcomes of this research project. Performance indicators of this research will include the application of streaming video technologies to multiple content areas - including campus and off-campus users. In addition, the partnerships developed with industry, such as Akamai or other industry partners, will be measured against the benefits to the institution.

Detailed Description

Applications for streaming video are various. They include: webcasts of special lectures; access to a rich educational video library; video and audio conferencing; the integration of video into course web pages; and the creation of video-based educational objects. The effectiveness of this technology to teaching and learning is largely untested, but none the less the demands to incorporate it into teaching and learning are starting to be met by the technology. Only recently has a distribution medium become available that allows full text searching of video, the application of metadata, interactivity, and other media in ways that make the use of video in education more flexible than ever before. Research into the tools, usability, educational effectiveness, and various solutions benefit current and future teaching and learning at our post-secondary institutions.

The focus is on three main aspects of streaming video. These are quality and performance, pedagogy, and business models. Compression algorithms, the end user software, or client, networking technologies and server solutions impact quality and performance. In order to study quality and performance, various partners around the world are providing and testing content. Other partners, that can provide performance enhancements to streaming video including, cable companies, phone companies, and broadband access providers is under investigation. Various solutions' quality and performance will be compared by individual reviewers and focus groups in several locations. Quality and performance will be tested given different conditions, including connection speed, time of day, distance from server, end-user platform, server characteristics, compression algorithm, and client. Akamai's Free Flow server technology will be tested to compare performance enhancements at a regional and international level. Campus and off-campus user tests will determine quality and performance standards for the main streaming video solutions.

Streaming video, in itself, is like any other video format from a pedagogical point of view. Video, in general, is considered linear and lacking interactivity. If putting learners in front of a video feed was effective, we would learn from home, in front of our televisions, watching a video taped lecture. Clearly, streaming video of lectures over the web does not represent any educational advantage over distributing VHS copies of lectures. However, the potential for the video and audio to contain additional information may provide an educational advantage. Using video taped scenarios that demonstrate procedures and principles can be an effective use of video. Marking up that scenario with additional information, or metadata, may demonstrate clear advantages for teaching and learning. Creating interactivity, allowing the learner to make decisions, search text, navigate non-linearly , and interact with the video may allow a learner more effective access to learning using video than previously possible. Demonstrating the possibilities is not simple. Tools that develop the metadata, and procedures that accommodate advanced content development for video are crude and difficult to use. In fact, although the need and technology exist, there no cost effective methods for creating a transcript of a video without the use of an individual typing what they hear into a computer. The expense of adding this metadata discourages its inclusion. The goals here are to demonstrate its potential and to discover processes and tools that permit the inclusion of metadata for streaming video. It is anticipated that this research will more clearly specify the need for content development software to be developed.

Associated with content development for the metadata of video are the data stores for the video and its metadata. There are several commercial database solutions currently available and establishing the criteria that matches sound pedagogy for the database is an important outcome of this study. One of the issues is extensibility of the database. Scalability, compatibility and reusability are all related to extensibility. The momentum of educational objects and IMS metadata standards for education dictate the need for the open, flexible standards and an object oriented approach. A solution where costs do not prohibit university access to necessary features, while offering security and intellectual property protection will be sought.

The third aspect of this research focuses on the costs, partnerships, infrastructure requirements, and opportunities of streaming video for institutions. In essence, a business model that can sustain the delivery of streaming video for the institution. Costs associated with video production, editing, and compression are high, adding in metadata and storing in it all in large database applications can be very high. Pricing varies widely between suppliers and solutions and an investigation into the details will lead to recommendations for implementation. Other costs associated with streaming video include servers, licensing fees, and Internet infrastructure. A detailed comparison of these costs against the performance and quality testing will lead to additional recommendations.

In addition to the cost/benefit analysis, the opportunities for collaboration with the private sector is being investigated. Opportunities exist that allow the university and its faculty to recover royalties to its intellectual property and charge for access to its servers. Streaming video over the web could prove to become the best distribution medium available for the thousands of hours of video already produced and owned by our institutions. Developing the types of partnerships and business models that could help support delivery, provide new content, build infrastructure, reach broader audiences, and maintain hardware and software is being prototyped at the University of Calgary.

Summary

The various complex issues from network, to compression, multimedia databases and usability require research, development, and testing to determine the best solutions for the institution. Guided by sound pedagogy, the framework suggested above is meant to get to some of the most important and practical issues, enabling the recommendation and adoption of solutions for the use by a post-secondary institution.

The Impact of Visualisation on Chemistry Teaching and Learning

Danica Dolnicar, Margareta Vrtacnik, Vesna Ferk
Faculty of Natural Sciences and Engineering, University of Ljubljana
Vegova 4, 1000 Ljubljana, Slovenia
danica.dolnicar@uni-lj.si, margareta.vrtacnik@guest.arnes.si, vesna.ferk@uni-lj.si

Mateja Sajovec
Simon Jenko Primary School
Ulica 31. divizije 7A, 4000 Kranj, Slovenia
mateja.sajovec@guest.arnes.si

Abstract: The availability of computers, the emergence of new visualisation and authoring tools and techniques, together with the expansion of web based learning environments and CD-based multimedia applications, offer chemistry teachers new possibilities for bridging the gap in students' knowledge and understanding of abstract and concrete chemical concepts and processes. This paper shows by example how the advantages of both the Internet and the interactive CD-ROMs can be used to improve students' learning at both macro- and microscopic level. We present results of a study of the effects of interactive multimedia teaching units on the quality of knowledge.

Introduction

The old Chinese saying, "a picture is worth a thousand words", has been proven many times by modern neuropsychological studies. Human beings can memorize 20% of what they read, and 30% of what they hear, but 40% of what they see, 55% of what they say, and 60% through active involvement; however, when all of the above sensory channels are used simultaneously, this results in the memorization of 90% of the content (Rose, 1993). According to the Gardner theory of multiple intelligences (Veenema & Gardner, 1996), we possess a number of relatively independent types of intelligences: linguistic, logical, musical, kinesthetic, spatial, inter- and intrapersonal. Each individual has the natural ability to use some of his sensory systems better than others. This shows that many different communication channels have to be used to achieve similar objectives with most of the learners. Spatial intelligence is commonly linked to visualisation and can, like all intelligences, be improved by various activities (e.g. in chemistry through use of models of chemical structures), which should be increasingly incorporated in the teaching and learning process.

In chemistry, three levels of visualisation are defined, which we explain by the example of chemical experiments. At the macro level, the real world is representable by photographs, drawings or video clips of the laboratory experiments. The 3D models of chemical structures or animations of chemical changes represent the micro level. At the symbolic level, chemical change is visualised by chemical equations or graphs. In order to achieve the learning objective, all three levels have to be correlated.

In this paper we present our work on the design, development and evaluation of interactive multimedia teaching units and web based teaching resources to be used at the primary and high school level. They can be used either for individual learning or in parallel with the traditional teaching tools in the classroom situation.

Development of multimedia chemistry teaching materials

In the design and implementation phase of the underlying CD-ROM applications of teaching materials all three different levels of visualisation in chemistry are taken into account. By using video, animations, and simulations coupled with interactive questions, games and problem-solving tasks, the users have, e.g. in the case of a chemical reaction, the possibility to observe chemical changes in reactants and products as well as energy changes, to follow them step-by-step, and then evaluate their observations. We try to simultaneously activate as many of their receptor channels as possible, and the use of nonvisual and static elements is kept to the minimum; the learning and testing

segments are tightly interlaced. Through communication - either live discussion with a teacher or via guided online discussion groups - the concepts learned are further clarified and relevant information is shared among the users.
The use of existing multimedia teaching materials in schools is supported by the intensive in-service training seminars for chemistry teachers. Teachers become prepared for active involvement in the development of teaching materials, produced by the University. To facilitate the needs of teachers and students, a specialized chemistry website named KemInfo was established. It includes a module on the visualisation of chemical structures and processes, together with tutorials for existing high quality educational multimedia CD-ROMs. It also provides the users with original interactive teaching materials, prepared either by teachers, through small-scale projects, or by the university lecturers. The teaching materials vary in size and complexity, the emphasis being on the applications using visualisation techniques (e.g. interactive maps of chemical reactions) and interactivity (collections of interactive exercises and games).

Evaluation of multimedia chemistry teaching materials

In spite of the rich assortment of educational CD-ROMs for chemistry, very little has been published regarding the impact of multimedia on the knowledge and motivation of students, let alone the cost-effectiveness of these products. In a research project, our own interactive multimedia CD-ROM, "Light and Chemical Change", was evaluated. The impact of multimedia on cognitive, motivational and motoric development of students was investigated in a qualitative study. The research involved a sample of 50 third-year secondary school students, who were divided into two proportional groups, namely the experimental and the control group. Both groups were pre-tested a week prior to the experiment through multiple-choice and open-answer written tests, so that the initial difference between the groups could be established. The experimental group then worked with the interactive CD-ROM in pairs, and they were given three hours to learn a specific content, presented by video clips, animations and simulations, accompanied by interactive questions with intelligent feedback. This group did not use any other source for knowledge consolidation. Students from the control group were also given three hours, with several course books available, starting with the teacher's explanation of the subject topic. A week after the experiment both groups took a post-test focused on understanding the concepts at the microscopic level of visualisation. The performance of both groups before and after the learning session was compared. Whereas the groups did not significantly differ at the beginning, the results of the post-test show significant difference in favor of the experimental group, which can be largely attributed to the visualisation elements included in the CD-ROM and its interactivity. In our ongoing research project, a study aimed at improving the efficiency of visual elements used in multimedia teaching units is being conducted. We are investigating the correlation between the spatial abilities of the individual students and their ability to correctly interpret different chemical processes visualised by application of the diverse tools.

Conclusion

Active involvement of teachers in developing high quality multimedia teaching materials is the key factor for their regular use in schools. The research on the effects of such materials is needed to provide the developers with the feedback. The use of visualisation elements at all three levels is crucial in chemistry teaching, however the learning process has to be supported by discussion and testing.

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Student Technology Services:
A Case Study in Experiential Learning
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Joe Douglas & John Grozik
University of Wisconsin, Milwaukee
Box 413, Bolton 574J
Milwaukee, WI 53223
jnd@uwm.edu
grozik@uwm.edu

Abstract:
A unique service organization, consisting exclusively of student employees, exists within the University of Wisconsin's Information and Media Technologies Division. Known as Student Technology Services (STS), this student managed organization is tasked with the operation of various computer, media and technology related campus services. STS employees work in all areas of I&MT including the Campus Computer Labs, Classroom Support, Desktop Support, Help Desk, Network Services, Peer Training, Photo Services, Printing Services, Shortcourses, Technical Resources, Video and Multimedia Production Services, TV Engineering, Distance Education Technologies, Visual Design Services, and Web Maintenance Services. More than 300 students are expected to be employed in STS by Fall 2000.

Student Technology Services (STS):
Student Technology Services (STS) is a student staffed, student managed organization responsible for delivering technology and media-related services to the campus community of the University of Wisconsin-Milwaukee. While empowered student IT workers are employed to provide a service, they are at the same time engaged in a learning experience. They are preparing themselves for their future careers through "experiential learning".

Student employees of STS come from virtually every academic major. Whereas many universities employ primarily technical majors under the mistaken belief that only they can satisfy their campus community's technology needs, STS instead looks for interpersonal skills, drive, and willingness to learn. STS has discovered that customer service and management skill sets have become as important as technical skills in the delivery of information and media-related technology services. Because most STS student employees do not have technical backgrounds, a carefully tailored training curriculum was developed and implemented. The purpose of the curriculum is to empower STS student employees by giving them the technical skills they will need to excel in their jobs as well as important professional and life skills they will need to excel in their future careers.

The STS training curriculum becomes an education when the learning is demonstrated through experience (i.e., implemented on the job) and when the experience is reflected upon (i.e., in an extensive oral and written evaluation.) Because completing the multiple levels of the curriculum, using the skill sets on the job and participating in the evaluation process are all mandatory conditions of employment, STS provides the setting for experiential learning at institutions of higher education. Many of the classes in the STS curriculum are developed and taught by STS students themselves. These STS Peer Trainers do not impose upon the institution's academic teaching mission, yet are an integral part of adding value to the learning experience of STS students. STS Peer Trainers are evaluated after each class they teach and are charged with making the necessary adjustments to their lesson plans.

In addition to the experiential learning provided by the curriculum, STS students are encouraged to transfer to other departments each year in order to learn and practice new skills. The exposure they gain in these other areas strengthens their learning experience and enables them to identify their personal and professional strengths and weaknesses. STS students are required to maintain a portfolio of their diverse work experience and training. The portfolio serves as the reflection piece to the classroom and on-the-job experience, thereby further adding value to TS' philosophy of experiential learning.

STS' focus on experiential learning has been met with welcomed enthusiasm at UW-Milwaukee. STS student employees are sought after not just for their learned technical skills, but also for the maturity and professionalism that they acquire through on-the-job experience and reflection pieces. UWM department heads specifically request STS student employees to be placed in their departments to troubleshoot and to maintain department web pages.

STS' example of experiential learning is now being introduced to the 26 other campuses within the University of Wisconsin System. Wisconsin's governor recognized the benefits of experiential learning as a means of preparing a qualified workforce in the state that can remain competitive even in the fluid environment of information technology. The Governor's Office recommended increased funding for training IT student workers throughout the entire University of Wisconsin system. His decision was based solely on the UWM STS model and its success. The biennium budget was signed into law in October, 1999 thus propagating the STS model of experiential learning throughout the state.

The STS program has generated strong interest from many academic and non-academic partners. We are exploring relationships with public school systems and with leaders in private industry to provide:

- A pre-college program to create work experience and training in technology for high school students.
- A similar work program focused on the two year technical college in Milwaukee
- Summer internships and potential scholarships for the STS student employees at UWM
- Meaningful industry relationships for students leading to employment upon graduation.

We have met with enthusiasm and willingness by all participants to work together on these new relationships. We look forward to a greatly enhanced student empowerment program when the new partnerships are in place.

Internet Connection

For additional information, please visit the STS web site at: **www.uwm.edu/IMT/STS**

The Effect of Level of Technology Training on Teachers' Attitudes Toward Using and Integrating Technology

Ronald Dugan, Jennifer Richardson, & Dianna L. Newman, Ph.D.
Evaluation Consortium/School of Education
University at Albany/SUNY
United States
rd1872@cnsvax.albany.edu

Abstract: This paper is a report of an ongoing longitudinal evaluation assessing the effect of level of technology training on teachers' attitudes and comfort toward using and integrating technology into the curriculum. Multivariate and univariate analyses were used on an initial sample of 54 K-12 public and private school teachers from a Northeast state undergoing two levels of technology training who participated as part of a Technology Literacy Challenge Grant. Initial findings support and extend previous research that shows teachers become more comfortable with using and integrating technology, and possess more positive attitudes toward technology, as the extent of training increases.

Introduction

Although over 8.5 million computers are being used for instruction in the U.S., and 85% of K-12 teachers have access to computers and other technology (Survey finds…, 1995), only half of all teachers report using computers for instruction (Hunt & Bohlin, 1995). Social learning theory (Bandura, 1977) predicts that failure of teachers to use computers will vicariously teach students not to use computers. This lack of computer use may be related to attitudes (e.g., anxiety) toward technology (Pina & Harris, 1993). Although ¼ of all people who use computers experience some degree of "computerphobia" (Rosen & Maguire, 1990), when teachers experience it, this interferes with their ability to integrate technology into the curriculum (Hunt & Bohlin, 1995). The strongest predictor of computerphobia is experience (Rosen & Weil, 1995). Limited research has shown anxiety towards computers decreases after training and practice (Cambre & Cook, 1987), yet only 29% of teachers report having more than five hours of technology training in the past year (Technology Counts '99, 1999).

The Study

The purpose of this study was to investigate the effect of level of technology training on teachers' attitudes toward, confidence using, and comfort with integrating technology. Attitudes were represented by three constructs: anxiety, avoidance, and fear of stereotyping. Confidence was measured in three areas: software, hardware, and communication tools. Comfort with integration was assessed by participants indicating one of six stages (awareness, learning the process, understanding and application, familiarity and confidence, adaptation to other contexts, and creative application to new contexts). Training occurred at two levels (Level I; 5 days training on using Power Point or Hyperstudio in the classroom: Level II; Level I training plus 3 additional days training in Web page design for curriculum use). Participants were 54 public and private school educators participating in a regional Technology Challenge Grant training program in a Northeast state. Twenty-six educators experienced Level I training while 28 educators experienced Level II training. Over 300 educators are expected to be trained at both levels by the end of this grant year. An end-of-year paper/pencil survey was administered to the first cohorts of educators experiencing both Level I and Level II training so far this school year. Ten items measured attitudes toward technology (anxiety, avoidance, and fear of stereotyping) on a six-point, Likert-type scale (1=strongly agree, 6=strongly disagree). Eighteen items measured confidence in using technology (hardware, software, communication tools) on a six-point scale (1=extremely confident, 6=not at all confident). The Stages of Adoption Scale (Knezek & Christensen, 1999) measured comfort with using and integrating technology into the curriculum.

Findings

A multivariate analysis of variance (MANOVA) was used to analyze the data. The fixed, categorical independent variable was level of technology training (Level I and Level II). The continuous, random dependent variables were confidence with using technology (software, hardware, and communication tools), and attitudes toward technology (anxiety, fear of stereotyping, and avoidance). Findings indicated no significant difference for level of training on confidence in using technology ($F=1.26$; $df=3,37$; $p>.05$). However, a significant difference was found for the effect of level of training on the construct of attitudes toward technology ($F=2.83$; $df=3,50$; $p<.05$). Examination of the univariate Fs indicated a significant portion of the construct was avoidance ($F=6.78$; $df=3,50$; $p<.05$) and anxiety ($F=6.61$; $df=3,50$; $p<.05$), accounting for 15% of the total variance (Wilkes lambda=.85). A univariate analysis of variance (ANOVA) was used to analyze the effect of the fixed, categorical independent variable (level of training) on the continuous, random dependent variable of comfort using and integrating technology (six stages: awareness, learning the process, understanding and application, familiarity and confidence, adaptation to other contexts, and creative application to new contexts). A significant difference was found for level of training ($F=5.00$, $df=1,50$, $p<.05$) on stage of comfort. Strength of association showed that nine percent of the variability in level of comfort could be accounted for by level of training. Those with more training were more comfortable with integration.

Conclusion

These findings support previous research that shows teachers who receive training in using and integrating technology into the curriculum experience less anxiety toward, and more comfort with, that technology. This study adds to existing literature by showing that additional training with more advanced technological software further decreases computer anxiety and increases comfort with integrating technology above and beyond less, and lower-level, training. If teachers are expected to integrate technology into the curriculum and model appropriate technology utilization behavior for their students, they need more training than the levels currently being received by most educators.

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LearnScope and the Development of Virtual Learning Communities

Allan Ellis
School of Social and Workplace Development
Southern Cross University, Australia
aellis@scu.edu.au

Robyn Weatherley
Training and Development Directorate
NSW Dept of Education and Training, Australia
rweatherley@cci.net.au

Abstract: The Vocational Education and Training (VET) sector in Australia is coming under increasing pressure, both nationally and internationally, to deliver courses in flexible ways that incorporate the latest in information and communications technologies such as the Internet and the World Wide Web. LearnScope is a national initiative funded by the Australian National Training Authority (ANTA). Its aim is to provide professional development support to individuals and work groups in order to develop skills and capabilities for the online environment

A preliminary study of LearnScope's Virtual Learning Community (VLC) was undertaken using a questionnaire based survey plus analysis of transcripts of forum discussions and published stories. The results highlight the complexity of the role of providing professional development for establishing online learning communities. The major areas of Technical Skills and Computer Literacy, Writing and Communication Skills, issues of Interactivity, and the development of Self-related attributes are identified as important if the VET sector is to build a critical mass of creative, capable instructors to work in the online environment.

The Changing Context of Vocational Education and Training

As the geographical boundaries of Vocational Education and Training (VET) in Australia become blurred, both nationally and internationally, the competitive edge of providers, Registered Training Organisations (RTO's), will not only be the courses and training programs they offer but the quality of instructor support and service provided to the learner. Information and communications technologies (ICT) such as the Internet and the World Wide Web has seen online interactivity emerge as a critical factor in delivering learning materials and supporting learners and instructors. A series of Australian National Training Authority (ANTA) reports (1994, 97 and 98) provide details to developments in this area.

Traditionally VET practitioners, in particular those in Technical and Further Education (TAFE) Colleges, have been provided with professional development to update their skills. In recent years this has been through work based learning using a range of processes such as mentoring, coaching, workshops, discussion groups, conferences and site visits. In the area of ICT, professional development programs have primarily focussed on technical skills development, that is, learning how to use the technology without focusing on the 'deeper' level of critically understanding the benefits and restrictions of using these tools in the learning environment.

LearnScope and its Virtual Learning Community

LearnScope is a national professional development initiative that is available to work teams and individuals within RTO's. It is focussed on the development of skills to deliver training in increasingly flexible ways using new ICT's. The LearnScope home page provides more details: http://www.learnscope.anta.gov.au/cover.html

For the individual instructors it is LearnScope's Virtual Learning Community (VLC) that provides a range of activities in several zones. These activities include:

- *About LearnScope* – an information about the national LearnScope project, guidelines and application forms and contact people within the project.
- *Key Issues* – an information area which provides clustered groupings of key issues relating to flexible delivery. This includes resources, text, access to software, people or web sites.
- *Project Gallery* – the area where LearnScope teams publish their plans, interim and final reports.
- *Expert Spruik* - an area to introduce key people who will contribute to the LearnScope VET community.

- *RantZone* – an area for people to practice their publishing skills, request information or make a statement.
- *Evaluation* – an area for the LearnScope's project evaluator to submit information about evaluation issues
- *What's New* – a frequently changing area which provides a summary of key information for all users.
- *Forums* - an area for both public and private discussions.
- *Chat Room* – an area for planned synchronous discussions.

While the VLC is primarily for the support of LearnScope project teams, anyone interested in the application of new learning technologies to achieve more flexible learning and professional development within the vocational education and training sector is welcome to register and participate.

The Survey: Methodology and Sample

Data was gathered in 1999 during two rounds of LearnScope projects and in two formats: a questionnaire, and forum discussions and published stories (Weathereley, 2000). A total of 58 questionnaires were distributed and 33 were returned giving a response rate of 57%. A total of 153 postings to 5 forums (average 14, range 10 to 21 participants per forum) as well as 336 published stories were also collected. These data was then used to:
(i) Identify the reactions, feelings and thoughts to using a virtual learning community in the context of the national VET system and to gain insight as to the level of experience of users.
(ii) Identify how VET practitioners used an asynchronous forum area set up specifically for learning.

Findings and Recommendations

It is recommended that for instructors or professional development planners who are engaging in developing online learning plans that the following areas of skills development and capabilities must be addressed:
(i) **Technical Skills and Computer Literacy**: To achieve the best possible learning environment it is necessary to go beyond the simplistic operational understanding of ICT. It is important to have the capability to make critical judgements about its appropriateness and to develop ideas about teaching and learning within the environment. The challenge for the national VET system is getting more people involved in a professional community which as Spitzer and Wedding (1995) says "...requires the active and willing participation of teachers in the process of examining, reflecting on, experimenting with, and ultimately changing the way they practice – in the context of a professional community that allows them to enrich their understanding of subject matter and to consider issues about how students learn."
(ii) **Writing Skill and Communication Style:** For online learning communities to be successful, the writing and language skill must be conducive to the audiences ability so that group interaction, sharing and participation can lead to an environment based on relationship development.
(iii) **Interactivity**
(iv) Understanding the range of interactive possibilities and promoting an environment which encourages active interaction online between people is vital. Understanding the significance of the human medium and the levels of interactivity will provide teachers with the potential to make critical judgements about student learning.
(v) **Self-related attributes**: Developing self-related attributes is significant in professional development for the online learning environment. Teachers need to identify, develop and model these attributes. Self-related attributes should also be an important aspect of learner development.
(vi) **Teaching and Learning**: Knowledge building in order to gain maximum benefits of an online community and to provide a quality learning environment, requires a range of strategies. Based on the constructivist model where learning builds on previous professional and personal experiences, the importance of linking practice with discussion, dialogue and debate in this new learning field is critical. Professional development activities need to incorporate pedagogical dimensions. These recommendations must be incorporated into instructor's professional development plans otherwise a quality online learning environment will not be achieved.

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Integrating WWW Technology into Classroom Teaching: Students' Perspectives of the Usefulness of their Course Web sites

Manal A. El-Tigi
Syracuse University
330 Huntington Hall
Syracuse, NY 13210
maeltigi@syr.edu

Abstract: The purpose of this study is to explore students' perceptions of the use of World Wide Web (WWW) technology as an instructional resource specifically customized to support teaching and learning practices on campus-based classes. While there are many efforts to design meaningful learning environments there is very little current instructional design literature on fostering and support of Web-based environments. This study examined college students' perspectives on the usefulness of specific Web site functions used for teaching and learning purposes, in an effort to optimize the use of Web-based instructional support resources.

Review of Relevant Literature

The 1999 Campus Computing Project's (CCP) national annual survey of information technology in higher education reported that many higher education institutions are providing more services via the WWW (CCP, 1999). For example, more than half (69.5%) of these institutions provide online undergraduate applications on their Web sites. More than three-fourths (77.3%) make the course catalog available online. A quarter (25%) of the institutions make library-based course reserves readings available online and almost a half (46.5%) offer one or more full college courses online via the Internet and the WWW. Similarly, the percentages of college courses using the WWW in the syllabus rose from 7% in 1995 to 28% in 1999 (CCP 1996). This number quadrupled by 1999 meaning that more than one in every four classes has a Web page. In fact, compared to e-mail and general use of Internet resources, use of Web pages has shown the highest rate of increase over the six-year period. E-mail had already been in use in 1994 rising to 54% by 1999 up from 44% in 1998, and 20% in 1995. Khan (1997) provided a definition of Web-based instruction used for the purpose of this study.

> Web-based instruction (WBI) is a hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is *fostered* and *supported* [italics added]. (p. 6)

At a university level, the *Syracuse University Faculty Syllabus Web site* available at http://syllabus.syr.edu is an example of a growing list of campus-based course Web sites. For the purposes of this study, a preliminary analysis of 175 Syracuse University Web sites was conducted during the fall 1998 semester.

Theoretical Framework

A conceptual framework was developed to ground and guide the research conducted in this study. There is evidence from research findings that certain principles exist in most successful teaching and learning practices (Chickering and Gamson, 1987, 1991). Second, there is evidence in the literature that the application of instructional design principles to the teaching and learning practices leads to more effective learning (Gagne' 1975, Gagne', Briggs, & Wager, 1992). One of the important measures of effective instruction is how students feel about the instructional process (Dick & Reiser, 1989). Based on the above premises, one can make the assumption that a well-designed instructional Web site can support and facilitate good teaching and learning practices and therefore can be perceived as a valuable instructional resource for both faculty and students.

Purpose of Study and Research Questions

The purpose of this study was to examine the opinions and perceptions of college students' use of the course Web site as an instructional resource for classroom-based teaching at a private university in the northeast of the United States. The focus of the study was on the identification of Web site functions that students' perceived as *supporting* and *enhancing* of their learning experiences by exploring students' perceptions of the usefulness of the various Web site functions. The following question was posited: How useful did students perceive their course Web sites?

Method

142 primarily undergraduate students enrolled in nine courses that employ Web sites as course resources responded to a questionnaire on their use of their respective course Web sites. Initially, all Web sites were first screened using an instrument developed by the researcher to evaluate the Web sites' instructional quality and design based on principles of instructional design. On the student Web site perception questionnaire (SWPS), functions pertaining to the Usefulness dimension were construct validated using confirmatory factor analysis. Two indexes were constructed for the *Usefulness* dimension using items that loaded (>0.60) on these two factors: GUIDE and PREPARE. The first represents practice, elicitation, and feedback functions. The second represents functions that facilitate recall of prior learning and enhance retention and transfer through communication, enrichment and remediation. All functions are derived from Gagne', Briggs, and Wagers' (1992) nine events of instruction and Chickering and Ehrmann's (1996) principles of good teaching and learning practices using technology as lever.

Results

Results showed that most functions were useful with a mean score for the PREPARE index (n=132, M=1.87, SD=0.74, scale 0-4 where 4=highly useful) and a higher one for GUIDE (n=131, M=2.20, SD=0.71, scale 0-4 where 4=highly useful).

The PREPARE index consisted of functions including: (a) the use of pictures, tables, diagrams, etc. to recall or present new information (n= 78, M=2.79, SD=1.00); (b) the additional links and information on the course Web site for further study (n= 96, M=2.43, SD=1.16); (c) the links to review/pre-requisite material to help recall (n=91, M=1.87, SD=0.74), and (d) overall usefulness of the course Web site (n=132, M=2.63, SD=1.13).

The GUIDE index consisted of functions including: (a) the opportunity to ask questions online (e-mail, listservs, hypermail, etc. (n= 112, M=2.74, SD=1.00); (b) posting graded assignments/Home Work on the Web (n=64, M=2.66, SD=1.30); (c) online practice assignments (n=47, M=2.64, SD=0.85); (d) online feedback on various assignments (n= 73, M=2.60, SD=1.00); (e) situations, case studies, formulas, problems, simulations, etc. posted on the course Web site to improve learning (n= 65, M=2.52, SD=0.99); (f) online self-assessment quizzes (n= 49, M=2.51, SD=1.23); and (g) instructions on how to navigate the Web site and download software, get an account, subscribe to a listserv (n= 100, M=2.30, SD=1.10).

Discussion

Key findings from the study are indicated below using Chickering and Ehrmann's (1996) seven principles of good teaching and learning practices for undergraduate education and Gagne', Briggs, and Wager's (1992) nine events of instruction as the framework for discussion. Findings for the PREPARE index related to assisting students to recall information and to transfer new knowledge were supported by functions representing two principles: (a) Good practice gives prompt feedback and (b) Good practice encourages contacts between students and faculty in that the most useful functions were those that enabled students to communicate with their instructors and to receive timely feedback. Electronic mail, computer conferencing, and the WWW increase opportunities for students and faculty to interact and communicate much more efficiently than before. In addition, the nature of communication becomes more thoughtful, deliberate, convenient and safe. Moreover, the negative aspects of face-to face confrontation are lessened. Findings from the GUIDE index indicated that Gagne's et. al. (1992) instructional events pertaining to presentation, practice, feedback, and elicitation of new knowledge and skills were overall most useful functions. The multimedia capabilities of the Web allow for an almost seamless integration of email capabilities, video clips, sound, images, and animation thereby allowing for multiple modes of communication through feedback and assessments. In conclusion, in terms of theoretical implications, the study supported the usability of Gagne's events of instruction in particular the ones related to presentation, practice, elicitation, and feedback, as a viable means of designing course Web sites to support teaching and learning practices. The study also provided empirical findings to support Chickering and Ehrmann's (1996) principles of good teaching and learning practices in particular the ones related to prompt feedback and student-faculty interactions. It is recommended that course Web site design could be optimized to include more instructional functions such as elicitation of responses, practice, feedback, and increased student-faculty interactions using the interactive and visual and auditory display capabilities of the medium.

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Evaluating Motivational Aspects of a Web-based English Language Course through the Website Motivational Analysis Checklist (WebMAC)

Anise D'Orange Ferreira
Graduate Program in Applied Linguistics
Catholic University of São Paulo
Brazil
anise@pucsp.br

Abstract: This work in progress short paper is a report on subjects' evaluations of a web-based language course's motivational aspects through WebMAC, *Website Motivational Analysis Checklist*, developed by Small and Arnone (1998). The subjects were 26 adult students who participated in a basic online English course for Internet users, focused on informal asynchronous and synchronous writing and communication skills, called *Surfing and Learning*. This course is designed by teachers and researchers of the EDULANG research group. The instrument measured the level of four motivation factors which provided the results for two dimensions within an Expectancy-Value framework: *Value* and *Expectancy for Success*. The evaluation results showed a high level of *Value* dimension and *Expectancy for Success*, although factors linked to *Expectancy for Success*, such as *Organization* and *Ease of Use* showed more variation in scores than those linked to *Value*, such as *Meaning*. Although WebMAC seems to be sensitive to student motivation, other kinds of data are required to a complete course evaluation. It will continue to be used for the ongoing evaluation of *Surfing and Learning* and other courses offered by EDULANG.

Introduction

Most researchers agree that motivation is a difficult construct to work with (Weiner,1990). Wlodkowski (1999) says that beyond the general understanding of motivation as a concept that explains why people think and behave as they do, "any specific discussion of the meaning of motivation brings in a cornucopia of differing assumptions and terminology"(p.1). According to Dörnyei (1998) motivation is a "process whereby a certain amount of instigation force arises, initiates action, and persists as long as no other force comes into play to weaken it and thereby terminate action, or until the planned outcome has been reached." (p.118). He also agrees with the idea that motivation is a multifaceted factor and no theory has yet been able to represent it in its total complexity. Despite difficulties, instructional designers continue to seek motivational frameworks in order to achieve a better design in tecnology based learning environments such as the WWW (Cornell & Martin, 1997). Duchastel (1997) elects two main models. One is Keller's ARCS model, considering four factors in motivation to learn: (a)ttention, (r)elevance, (c)onfidence, and (s)atisfaction. The other one is Malone's CFC framework for instrinsically motivated inscruction, which involves three factors: (c)hallenge, (f)antasy, and (c)uriosity. ARCS guided interventions reduced the drop out rate, by half, of a Master's degree distance course intended to prepare adult students for careers in the areas of instructional design, job performance improvement, etc. (Chyung, Winiecki and Fenner,1999). Also influenced by the ARCS model, the *Website Motivational Analysis Checklist* - WebMAC (Small & Arnone, 1998, 1999) was designed to assess the motivational quality of a website. Small (1997) claims that, although the ARCS model is rooted in a number of motivational theories, its main basis is the expectancy-value framework in which motivation to behave is the sum of individual's expectancy for success in a given task plus the value attributed to success in the task. Website quality is measured within expectancy-value framework: the user is motivated to remain in the website if it has value and if the user expects to be successful in the website environment. Dörnyei (1998), surveying motivation in second and foreign language learning (L2) research shows that researchers have adopted and empirically validated some concepts originally introduced by motivational approaches in mainstream psychology, such as expectancy-value theories, goal theories and self-determination theory. Therefore, WebMAC was chosen here to evaluate motivational aspects in a L2 web based instructional design. This evaluation is part of a major research project in which the analysis of interactive flow is also considered (see Collins' paper).

Methodology

The subjects were 26 students, male and female, age 29 to 64 , who participated in a web-based language course in 1999. The course, *Surfing and Learning* (http://cogeae.uol.com.br/sal) offers a basic English for adult Internet users, focusing on informal asynchronous and synchronous writing and communication skills. It was designed by English language teachers, members of EDULANG research group, under the coordination of Heloisa Collins, in the Graduate Program in Applied Linguistics of the Catholic University of Sao Paulo (LAEL/PUCSP). WebMAC versions 3.1 and 4.0 were translated into Brazilian Portuguese and edited into a HTML format, so that the students answered the checklist anonymously at the end of the course and submitted it through a CGI implemented web form. The answers were scored according to WebMAC scoring guidelines. Both versions were used and the scores obtained from 3.1 version were adjusted to version 4.0 factors. WebMAC is composed of assertions or list items to be rated by an evaluator on a 4-point level of agreement scale. The 32 items in version 4.0 measured 4 factors: 1) Stimulating ; 2) Meaningful; 3) Organized and 4) Easy to use. The sum of first two equals the *Value* dimension level; the sum of the other two equals the *Expectation for Success* dimension level. Zero to 8 points for a factor means the site needs much improvement on this factor; 9 to 16, it needs some improvement, 17 to 24 means the site is highly motivating. Version 4.0 contains four additional unscored items: two yes/no assertions and two open questions. Most of list items are the same in both versions. However, they are not related to the same factors. In both versions, each subject provides two main scores that are plotted on a bidimensional grid: 1) Low Value to High Value and 2) Low Expectation for Success to High Expectation for Success. The score position reflects the motivational status of the site in terms of *Value* and *Expectation for Success*. (fig.1)[figures at http://www.anise.f2s.com/anise-edmedia.html]

Preliminary findings

The results (fig. 1) show the scores on the average to high-level area of *Expectation for Success* and *Value*. Only two students showed low *Expectation for Success* and only one gave low scores to *Value* dimension factors. The individuals' scores under each of the four factors (fig.2) show less variation for the *Meaning* factor than *Organized* and *Easy to Use* factors. The answers to WebMAC open questions presented in 4.0 version revealed some students' satisfactions and dissatisfactions. Despite high levels of *Value* and *Expectation for Success*, the amplitude of scores in each of the four factors suggests that the course can be improved in *Organization* and *Ease of Use* factors. The interaction in communication areas of the course was pointed out by students as a particularly strong aspect of the course design. The complaints about tools and dictionaries seem to confirm comparatively lower scores of *Organization* and *Ease of Use* factors. Future work should consider the use of WebMAC during the course. These results can be discussed in terms of guidelines for motivating language learners (Dörnyei, 1998). Although the present instrument seems to be sensitive to student motivation, other kinds of data are required to complete the course evaluation, such as the interaction flow analyses. The ongoing evaluation of *Surfing and Learning* and other courses offered by EDULANG, such as *Reading* and *Listening Comprehension* for public high school teachers, will continue to use WebMAC.

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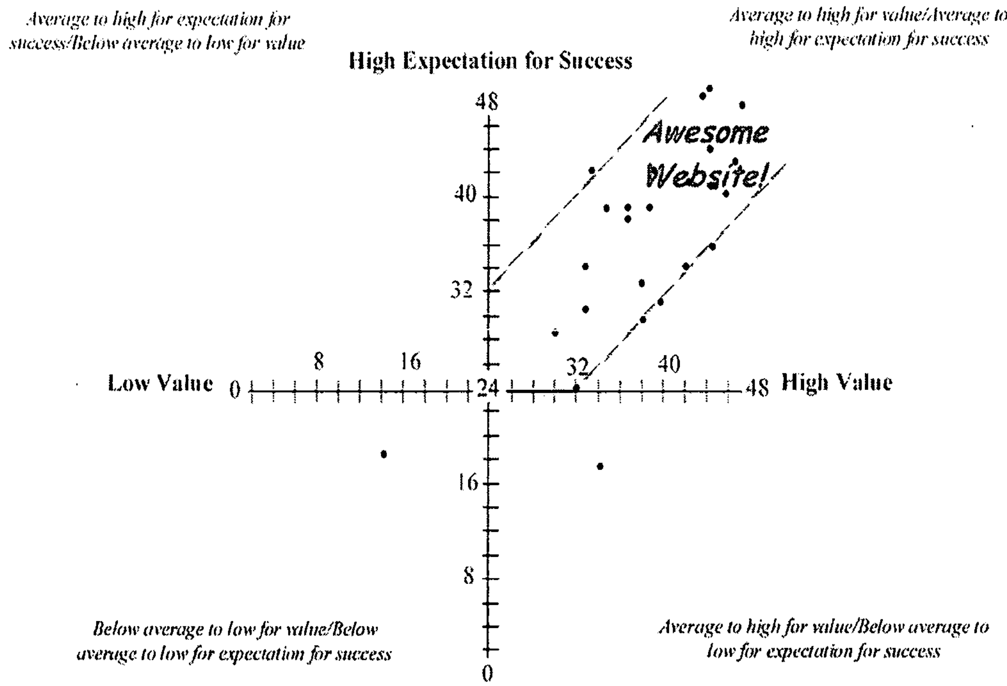

Figure 1. Plotted scores on WebMAC bidimensional grid (N=26)

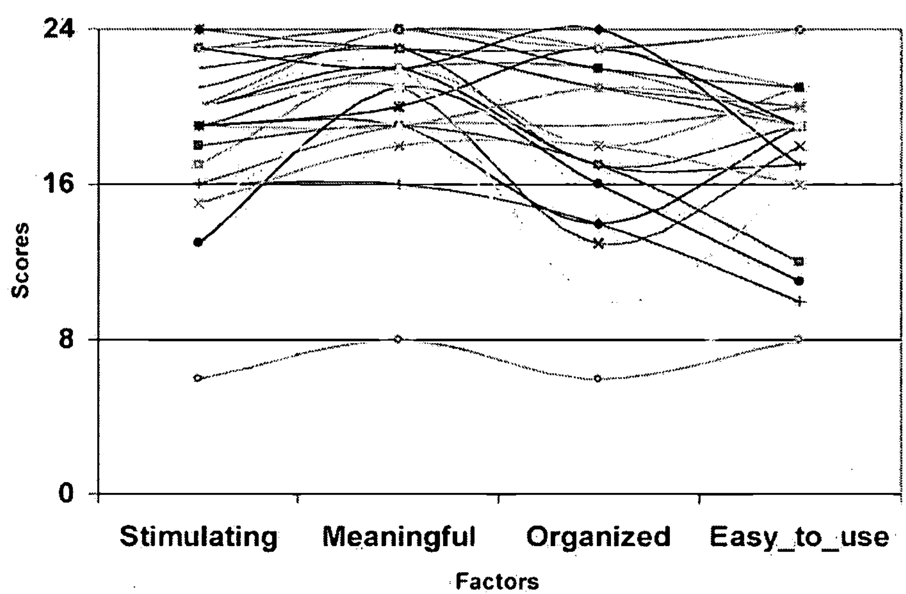

Figure 2. Individual scores related to the four WebMAC (v.4.0) motivational factors (N=26)

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A Catalyst for Collaboration: Using Partnerships to Support Technology in Teaching

Louis Fox
University of Washington
Office of Educational Partnerships
Seattle, WA 98195-1209
lfox@u.washington.edu

Tom Lewis
University of Washington
UWired Center for Teaching, Learning & Technology
Seattle, WA 98195-3080
tomlewis@u.washington.edu

Scott Macklin
University of Washington
Program for Educational Transformation through Technology
Seattle, WA 98195-3080
smacklin@u.washington.edu

Abstract: UWired created the web-based Catalyst initiative to support innovation in teaching through technology. To scale beyond early adopters, Catalyst has developed a new strategy centered on collaborative partnerships with campus teaching practitioners—learning, technology, and teaching research centers, libraries, and departments—to disseminate innovative uses of technology in teaching through the Catalyst website.

The Problem of Supporting Innovative Teaching with Technology

In 1994, three top-level administrators at the University of Washington were charged by the Provost to "do something about technology." Collaborating with faculty, librarians, technologists, and students they quickly moved beyond a small pilot, rounding up partners and gathering resources from wherever they could to focus on bringing technology into the service of teaching and learning. Today the organization they formed—UWired—has a permanent budget, a staff of eight professionals and over 60 students, and has extended services and support to thousands of students and faculty.

As higher education institutions have scrambled to keep pace with rapid changes in information technology, many campuses have established faculty technology centers, offering workshops and training to interested educators and perhaps even supporting faculty technology projects to transform particular courses. These efforts have generally targeted "early adopter" faculty who are eager and willing to teach themselves how to use and implement new technologies. Resources are thus devoted under the assumption that early adopters will play the role of Johnny Apple-Seed, spreading innovation throughout their home departments. Indeed, UWired inaugurated its Center for Teaching, Learning and Technology (CTLT) to foster and support instructional innovation in this manner.

For the most part, however, this strategy has had a negligible impact on educational transformation through technology. Beyond the few early adopters are legions of "wary adopters" who look for easy ways to improve their teaching through technology but are unwilling to match the time commitment of the "early adopters." The classic early adopter is drawn to technology for its own sake, reveling in the "gee whiz factor" of new technologies, but "wary adopters" are pragmatic. Representing the mainstream of higher education faculty, "wary adopters" will use technology only when it can be demonstrated that doing so will add value to their teaching without significantly reducing time already allocated to teaching, research, and service activities. Needless to say, the CTLT found it quite difficult to scale up support services while also ensuring that these services meet the often different needs of "wary adopters."

Creating a Catalyst for Innovative Teaching with Technology

The need to expand support to a much wider audience—and to do so without a major infusion of new staff or relocation to a larger facility—was clear. How to do so was not. In fact, the CTLT faced four major obstacles posed by the needs of "wary adopters": (1) the absence of a coherent framework for faculty Web publishing, (2) the absence of well explained, compelling examples of enhanced teaching and learning through the Web, (3) the absence of convenient, in-person support located in departments, and (4) the absence of a clear incentive for faculty to explore the use of technology in their teaching. After an intense period of reflection and wide ranging conversations with campus stakeholders and faculty focus groups, the CTLT's leadership team developed a new framework for faculty support. The framework depended upon an instructional support Web site that would provide faculty with anytime-anywhere resources and also serve as the foundation for redesigned instructional workshops and one-on-one consulting.

The Web site, Catalyst, was launched in 1999 to provide this support while placing pedagogy and student learning at the center of the discussion about technology. Catalyst is based upon four assumptions: (1) faculty want just-in-time learning and support; (2) they prefer to learn at their own pace, in their local environment; (3) the Web is or will become the vehicle of choice for just-in-time information and learning; and (4) distributed support personnel are best suited to make the critical decisions about local infrastructure and local support. Given this, the key function for Catalyst—the value add—is in capturing, focusing and disseminating ideas, resources, and tools that allow both faculty members and local support personnel to make innovative use of new technologies in teaching and learning with a minimum of duplicative effort.

Scaling Innovation through Partnerships and Collaboration

Through Catalyst[1], UWired can easily identify promising practices from within the campus and then use them to address enterprise-wide educational needs. As an easily navigable clearinghouse for information on the use of the Web in teaching and learning, the site has met faculty needs and drawn repeat visits, creating a center of gravity for innovation in teaching with technology that far exceeds the physical reach of UWired and the CTLT. Catalyst has four basic types of content: (1) profiles of educators and programs that provide a vehicle to share ideas and experiences with technology, humanizing its use and, hopefully diffusing teaching innovation; (2) guides to instructional methods and technology tasks that provide a map to a wide range of individual documents geared towards improving learning; (3) dynamic content and frequently updated information on news and events relevant to teaching with technology; and (4) instructional tools that provide a standard mechanism for faculty to create interactive, Web-based instructional modules in any computing environment using only a Web browser.

As envisioned, departments and college support personnel who have developed materials specific to their local computing environments—for instance how-to documents on a particular Web editor or "one-off" Web-based instructional tools—have been eager to see their work repackaged and made available to a much larger audience. More, through a partnership with a university-wide initiative, the Program for Educational Transformation through Technology (PETTT), UWired now has the capacity to conduct research on the science of learning and disseminate information via Catalyst, thus promoting the thoughtful exploration, development, assessment, and dissemination of next-generation technologies and strategies for teaching and learning.

Catalyst not only extends UWired's reach, but it also improves the overall quality of faculty support, providing department support personnel with a set of resources they can draw upon, freeing them individually tailor services to their faculty. By aggressively profiling the efforts of campus educators, Catalyst makes faculty innovation visible and contributes directly to the vitality of the teaching community on campus. In its first year, the Catalyst Web site logged half a million page views; it now averages 100,000 page views per month.[2] On the UW campus, over 1000 faculty and instructors from departments ranging from Anesthesiology to Urban Horticulture have implemented Catalyst tools.

[1] See http://depts.washington.edu/catalyst/home.html
[2] See http://depts.washington.edu/catalyst/2000_report.pdf

Health Issue for Human Computer Interaction in Electronic Learning Environments

Dr. Joy Fraser
Dr Peter Holt
James Mackintosh
Athabasca University
1 University Drive
Athabasca AB
Canada
T9S 3A3
Voice: 780 6756111
FAX: 780 6756186
Email: joyf@athabascau.ca
Email: holt@athabascau.ca

Abstract: Social pressures are creating the necessity for a system of lifelong learning. Electronic distance education appears to be the optimal system for meeting the educational requirements of learners. While educational needs have shaped the development of the electronic learning environments there has been little attention paid to the physical and psychological health issues for the electronic learner. Athabasca University (AU) has used questionnaire and focus groups to examine the implications for learners using AU's electronic environments for learning.

INTRODUCTION

Distance education is often identified as a panacea for adult learners as it overcomes geographical barriers that often prevent students from attending universities to study. With the advent of the Internet as a readily accessible medium, web-based courses have become immensely popular with providers of distance education around the world. It clear by the enthusiasm with which computer-based distance delivery has been embraced that society is willing to rely on computer technology for learning.

At Athabasca University, where the mandate is distance education , students are distributed not only across Canada where the University is located, but also across North America and the rest of the world. For the past five years Athabasca University's Centre for Computing Information Systems and Mathematics (CCIS) has offered 20 undergraduate Computing Science courses over the World Wide Web (WWW). In 2001 it will be offering a Master of Computing and Information Systems over the WWW. The Center for Nursing and Health Studies (CNHS) has offered a Master of Health Studies (MHS) degree over the WWW since September, 1999 and in less than a year has over 200 graduate students enrolled in the program.

The needs and capabilities of the learners are our first considerations in the development of an electronic learning environment. In our developments we have focussed on involving the learners to optimize the environment for learning (Holt, Stauffer & Jelica, 1999). However, until recently we did not look seriously at health related issues. Marcoulides, Mayes, and Wiseman (1995) have suggested that the use of computers in the workplace can result in anxiety. Similarly, technology-based learning may result in added stress among learners. There are other potentially negative implications for students who rely on computers for learning. According to Faulkner (1998) these may include psychological factors such as alienation, inadequacy, lack of privacy, loss of responsibility and damage to self-image. Furthemore, Dix et all (1998) noted that physical problems include repetitive motion strain, postural fatigue, eye fatigue and less frequently, skin rash, reproductive disorders, and cataracts.

In order to examine health issues related to the use of computers for learning, we decided to survey graduate students in our Master of Health Studies Degree and undergraduate students in Computing Science. Questionnaire data has been collected on general computer-related habits, any health problems encountered, and their ergonomic awareness related to design of workspace, posture, usage, and exercise. This was a large exploratory study with a questionnaire of 19 items distributed to 1310 CCIS Students and 145 CNHS students). More indepth data will be gathered by focus groups which are underway--the results and will be reported more fully at EdMedia 2000. The more interesting questionnaire results analyzed to date are presented in this session.

CNHS students and CCIS students differed on a number of dimensions including graduate versus undergraduate, continuous monthly enrollment versus semester, discipline, and different WWW-based learning platforms. Since the purpose of the study is to consider ergonomic factors in the design of electronic curricula for both CCIS and CNHS students, we have not focussed on inferential statistics and differences between the groups but upon useful descriptive statistics within each group.

The return rate was low for CCIS students (150 of 1310 questionnaires). It was higher for CNHS students (41 of 145 questionnaires). The low return rate makes the results more difficult to interpret as students with health related problems may be more likely to respond giving us a biased sample. Nevertheless, computer usage was reported to be very high among respondents. Both CNHS students (80.5%) and CCIS students (85.3%) had high rates of computer use in general and relatively high use for education other than the current courses (43.9% and 72.3%). The mean time using computers was 24.2 hours per week for CNHS students and 32.2 hours for CCIS students. There was a wide range of usage but it would appear these are high-use groups at risk for computer related health problems.

CNHS students and CCIS students rated themselves respectively as somewhat or informed (75.6% and 63.4%) about ergonomic issues. However, a majority of all students did not make use of special ergonomically sound furniture and at least half of both CNHS students (53.7 %) and CCIS students (50.0%) did not take any regular breaks while working at the computer. As high usage groups these students ought to be more aware of ergonomic issues and in ideal circumstances, practice more ergonomically sound computer usage.

Both CNHS and CCIS students reported some physical problems related to computer use (26.6% and 26.8% respectively). Problems reported include carpal tunnel syndrome, eye strain, and back strain. Ironically, although both groups reported low rates of psychological problems (9.8 % and 6%), they did report considerable levels of anxiety about their use of computers. Interestingly, the most intense anxiety was associated with issues of privacy and security with 70.7% of the CNHS students and 65.1% of the CCIS students reporting slight to high levels of anxiety in this area. Other areas of anxiety included the cost of computer technology (46.3% and 57.7%); keeping current with software (46.3% and 40.3%); loss of data (43.9% and 60.8%); keeping current with technology (34.1% and 40.3%; and keeping up with the information glut on the Internet (36.6 and 47.7). High computer usage does appear to affect these students' social/family life--36.6% of the CNHS students and 34.7% had complaints from family members about their computer usage. This finding is hard to interpret in lack of comparison with students learning by other methods of education but it certainly warrants further attention.

Of the CNHS students 32.5% reported that the electronic courses aggravated old problems, 50.0% said they created new problems, and 51.3% had suggestions for course design. Of the CCIS students 12.7% reported that the electronic courses aggravated old problems, 16.7% said they created new problems, and 30.7% of CCIS had suggestions for course design. When students listed concerns most of them were related to computer use or course design rather than to health related problems explicitly (other than perhaps related to stress). This could be a function of students being so engrossed in their use of computers for learning that they are relatively unaware of health problems. We are conducting further focus groups to further investigate the factors and underlying situations that contribute to students being in undesirable physical and /or psychological danger and other ameliorative approaches they might use. On the basis of findings to date we are implementing a Java/XML based printing utility and highlighting ergonomic tips in the course materials.

DESIGNING SYNCHRONOUS INTERACTIVE LEARNING TELECONFERENCES: Digital Field Experiences at the Columbus Zoo, an Informal Science Contextual Setting

Tamara J. García-Barbosa,
Andrea K. Balas,
Dr. Barbara S. Thomson,
The Ohio State University
249 Arps Hall, 1945 N. High St.
Columbus, OH
garcia-barbosa.1@osu.edu

Abstract: The Columbus Zoo has a Distance Learning Interactive Field Experience Teleconferencing program (CZDLIFE) to provide a vehicle to enhance standards-based math and science instruction in Ohio's schools. The use of interactive technology in schools can increase the ability to use contextual settings in education which add a level of reality to classroom learning. Making connections through planned partnerships outside the traditional classroom promotes curiosity, creativity, and exploration. Learning in an informal setting helps students connect and transfer their knowledge base as they engage in new learning opportunities. Zoos can provide an excellent informal context to ground distance learning interactive field experiences.

The Project

The goal of the Columbus Zoo Distance Learning Interactive Field Experience (CZDLIFE) is to offer educational and scientific resources to enhance standards-based math and science instruction using two-way audio/video interactive technologies. The CZDLIFE provides an exciting and meaningful curriculum that incorporates a variety of activities for all students at the distant site. The instructional design of the project was grounded in contextual teaching and learning theory and situated learning environments (Brown et al. 1989, Balas, 2000). The design emphasizes the use of several pedagogical strategies blended with contextual experiences that promote real-time problem-solving interaction. These experiential activities are designed to promote knowledge creation through interaction with zoo facilitators and other learners (Thomson, B., et al. 1999). The field experience was constructed using six key areas: 1) considerations to connections to the curriculum, 2) connection to multiple content areas, 3) inclusion of non-formal educators in the design phase, 4) developmentally appropriate activities, 5) professional development activities, and 6) follow-up activities (Francis, 1999).

Research Problem and Question

The Columbus Zoo has experienced a great deal of success implementing on-site and outreach educational programs. The recent advent of the use of two-way audio/video interactive teleconferencing as a means of sharing the zoo resources has added a new and complex medium for educational content delivery. Interactive teleconferencing is a unique medium that requires different and diverse pedagogical approaches than those regularly used with on-site visitors and outreach populations. The main benefit of two-way interactive teleconferences is that the nature of the system provides a level of intimacy in communication that is not apparent in other forms of distance learning. Two-way real time video transmission of information implies a new definition of real-world context, in which the learning environment, although video-mediated, is indeed the actual environment with which the learner interacts (Jonassen et. al. 1995). Another strength of the technology lies in its synchronous nature; the teacher and learners experience parallel delivery and reception of information without a time delay.

In order to add to research based design, the main question of the study is How do you design effective standard-based two-way synchronous teleconferences from an informal education setting?

Research Design and Procedures

Background research in the development of interactive teleconferences in contextual settings such as the zoo is almost non-existent. The study involves the Columbus Zoo, in Columbus Ohio, and four distance learning sites throughout the state. The four sites were divided among three schools in New Lexington, Stark County, and Richfield, Ohio; and one community-based after-school enrichment program, which used the Cincinnati Zoo as their teleconferencing facility. Five elementary school teachers, one principal , four technology coordinators and seven classes were used for data collection. The student population ranged from second to fifth grade with a combined total of 140 students. This population is representative of Ohio's urban, suburban and rural students.

Qualitative data was gathered through surveys, interviews, observations, field notes, and researcher reflections. Surveys were collected immediately after the CZDLIFE, and interviews were conducted with the teachers and technology coordinators prior to and after the CZDLFE teleconference. The qualitative data was interpreted through the development of common themes generated from the interviews and is being synthesized into assertions about the nature of the experience.

Preliminary Results

The CZDLIFE teleconferences use a view of learning that encourages knowledge creation rather than a knowledge delivery. For most learners having tactual contextual opportunities is critical to accommodate for their learning styles (Thomson, B., et al. 1999). The CZDLIFE program has been effective in providing an opportunity to:

1. Bring to the zoo a wider student audience.
2. Help meet the needs of students who are unable to attend on-site programs.
3. Provide real time face-to-face interaction between classrooms and zoo educators.
4. Involve outside speakers who would otherwise be unavailable to regular zoo visitors.
5. Provide an opportunity to "export" unique exhibits such as the coral reef or some of the endangered animals that can not be used on regular zoo outreach programs.
6. Allow "real time" 2 way audio and video contact between students and the facilitators at the zoo.
7. Incorporate the use of experiential learning activities, live action and pre-recorded video to present interactions carried out at the zoo which are not available to the general public.

Implications

The results and conclusions of this program help provide a better understanding of design process for interactive distance learning field experiences in informal science settings. The study also serves as one of the few studies that examine the outcomes of using two-way interactive distance learning between elementary classrooms and an contextual learning setting.

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Implementing Interactive Multimedia Courses for the WWW Using Streaming and SMIL Technology

Thanasis Giouvanakis Haido Samaras Konstantinos Tarabanis
University of Macedonia
156, Egnatia Street Thessaloniki, Greece
Tel: +30-31-891589, Fax: +30-31-891544
E-mail: thgiouv@uom.gr, hsamara@uom.gr, kat@uom.gr

Abstract: This presentation reports on our current and on-going R&D efforts towards the design and development of multimedia, web-based courses suitable for use through the Internet. We discuss the process that has been adopted in designing the interface and the tools used. An important issue for the implementation of the courses is the use of streaming technology for the reliable transmission of multimedia content material over the Internet. This technology allows us to transmit multimedia data in a more efficient way and to introduce interactive elements using SMIL (Synchronized Multimedia Integration Language).

Introduction

Until now, the traditional educational system has assumed that all students learn identical materials via the same delivery mode. However, it is known that each student's intelligence profile and learning style is unique and therefore, the traditional lecture-based method of classroom instruction cannot accommodate the large number of diverse learning preferences. In this context, the Internet has emerged as a new means for meeting the needs of individual learning diversity and has introduced significant opportunities for the improvement of the educational process.

However, although significant investments have been made for the technological support of this new educational environment, similar steps have not been taken towards the creation of noteworthy educational software. Thus, although a vast amount of electronic educational material currently exists on the Internet, it is usually in the form of simple text occasionally combined with some graphics. Undoubtedly, there is a lack of genuinely qualitative educational content. This is due mainly to the fact that the current Internet infrastructure is incapable of transmitting high-quality multimedia content (a problem which can partially be addressed by the use of streaming technology). In addition, the significant expense and time required for the development of such material are serious prohibiting factors.

This paper discusses our efforts towards the design and development of interactive multimedia, web-based courses suitable for use through the Internet. The primary characteristics of the material developed are the following:

1. It is dynamic and interactive.
2. It supports the concept of collaborative learning i.e. it offers opportunities to simulate real situations of collaboration among various groups of users.
3. It can be transmitted efficiently to users.

Designing the interface

The appropriate design of the interface depends on the specific context that it is intended for. To this purpose, an effort was made to create an interface, which would be used by adult graduate and post-graduate students and would use unambiguous "metaphors" for the effective and consistent delivery of specific concepts to learners. The screen was divided into three vertical frames, the left of which always displays the contents of the course. The middle frame presents each individual course in the form of text while in the third frame, accompanying graphics, video or animation, can be viewed by the user, depending on the requirements of the specific material being worked on. It is important to emphasize that that each lesson is available in several different forms of delivery i.e. text, narration, etc.

Implementation of the educational material

On a technical level, the implementation of the courses was based on the use of:

a) Streaming technology
b) HTML, JavaScript, VBScript, XML (SMIL), ASP

Streaming technology for the efficient transmission of multimedia elements

One of the basic problems encountered during the implementation of a multimedia, web-based course is undoubtedly the limited bandwidth of the Internet. This is perhaps one of the main factors that justify the lack of extremely high-quality multimedia material. The greatest amount of educational software existing presently on the Internet is in the form of simple text, frequently enriched with some graphics. This form, however, proves to be inadequate.

Streaming technology addresses this problem in the following way:

Although, the conventional way of transmitting data through the Internet requires that the entire file (e.g. a video file) be received before it may be viewed by the user, this is not a necessity when streaming technology is the adopted method. In the latter case, the information is presented to the user (e.g. the video file begins to "play") even though the remaining information is still being received and it becomes possible to view the multimedia elements almost simultaneously with the appearance of the rest of the HTML document.

A primary advantage of this kind of technology is that it is possible to transmit very large multimedia files in an efficient and reliable way thus resulting in the preservation of the learner's concentration.

Streaming technology makes use of the RTSP (Real Time Streaming Protocol) instead of the HTTP protocol.

The product selected to deal with the difficulties associated with the network infrastructure of the Internet was the RealServer created by Real Networks. RealServer makes it possible to incorporate high-quality multimedia elements (RTSP is designed to stream clips that have time lines) within a web-based course. Whether the learner has an ISDN line or accesses the Internet through a low-bandwidth connection, s(he) may still view a course that comprises a variety of multimedia elements. There is also a possibility for the dynamic detection of different connection speeds between the client and the server so as to achieve improved transmission.

Emphasis should be given to the fact that it is possible to include additional interactive elements within the educational material (sound, video, animation) through the use of the SMIL language.

Interactivity

An additional item of concern was that the educational material should be enriched with a variety of interactive elements. To this extent, SMIL (Synchronized Multimedia Integration Language) presents notable interactive characteristics.

Based on XML, this language reacts upon the multimedia elements of the course, which are transmitted through the use of streaming technology.

The main reasons that make SMIL so important are:

a) It can integrate and co-ordinate many diverse types of multimedia information. We can capture events that are generated from the interaction between the learner and the multimedia element. This is achieved through the use of callback methods.

c) It can be considered as an "open", platform-independent technology, which is based on W3C XML.

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Narrative, Context and Cognition in Interactive Media.

Lisa Gjedde
Research Centre for Educational ICT
Royal Danish University Of Educational Studies
Emdrupvej 72
2400 Copenhagen NV
Denmark
Lg@dlh.dk

Abstract: Based on case-studies of edutainment Multimedia programmes this study is exploring the affordances of the contextual elements of narrative in relation to interactive Multimedia programmes, the possible cognitive costs that lack of canonical narrative elements may have for the user and the particular possibilities they may offer in a learning environment in which meaning, experience and motivation for further exploration are key elements.

Narrative and the user`s construction of meaning

Educational or edutainment Multimedia programs are offering new environments for learning and communication (Gjedde 1999a) but often these programs are not employing the canonical narrative elements that can be found in popularization of complex information in television, magazines or in books. Instead there has been a natural interest in exploring the non-linear possibilities that the interactive media is offering. This has been done while letting go of the canonical narrative elements and schemata's that typically has a beginning including a notion of time, place and a protagonist, a development and an end (Bartlett 1932 1995; Labov 1972). Research on the relationship between narrative structure and cognitive processes like memory and comprehension has indicated that there tends to be better memory and comprehension for texts that employ a narrative structure than texts that do not use a narrative structure.(Thorndyke 1977; Mandler 1984). Narrative theories are furthermore pointing to its importance for experience, identity and communication. (Schank 1990; Schank and Abelson 1995; Schank 1997).

The structuring and communicative elements of narrative are often not used in educational or edutainment Multimedia programs, which are often encyclopaedic in structure and if using other structures as a motivating factor, tend to use games that often do not have the basic narrative elements. They are not embedding the information offered in the context and structure of a narrative, but it is instead presented in an abstract cyberspace, or in an encyclopedic structure that does not provide the same cognitive and experiential level of support for the user.

This lack of narrativity can have consequences for the ability of the user's to construct meaning from the seeming chaos gathered by experiencing information that is presented out of a context or a known and comprehensible universe.

This can be found in the edutainment/educational genre, where the user may be particularly vulnerable to the lack of cognitive support for the organization of the material, that a narrative structure may provide.(Plowman 1996; Plowman 1998)

The user may also lack the involvement, which the narrative can create through an experiential dimension, through the unfoldment of a narrative, with the possibilities for emotive and identificatory involvement and a narrative logic with an explicit causal structure. These factors may be of importance for the learner's motivation and construction of meaning, particularly the possibility for making a connection between the information they may gather through the program and their present experiences and knowledge structures. (Sarbin 1986; Schank 1990; Gjedde 1998b)

Previous research in this area, has looked at various CD-ROM's in the edutainment and educational genre (Laurillard and Taylor 1994; Plowman 1998). There are indications that a non-narrative or encyclopeadic structure tends not to support the user's construction of knowledge or perception of global coherence to the extent that the narrative that may be found in books and television typically does.

An empirical research project with an experimental design, the MENO-project (Multimedia in Education and Narrative Organisation) has experimentally employed different types of structure in an interactive educational program. (Laurillard and al. 1995) (Plowman, 1999). It was however focused on the structural manipulations and not on a narrative embedding of the material through a consistent main character that provided a focus for identification, or the point of view of a narrator.

This type of narrative embedding may be found in several successful popular science productions. An example of this is the best-selling novel by Jostein Gaarder about the History of philosophy: *Sophies World* (Gaarder 1992), which became the world's most sold book in 1995. A CD-ROM production was made on the basis of this book within the genre of edutainment, which was based on some radically different structures. In the CD-ROM version some of the canonical narrative elements have been replaced by a NLP-generator, which is capable of having a primitive dialogue with the user; and with a number of game elements.

Based on a pilot project with a case-study of some users of this CD-ROM I have identified some potential problems that will be further explored in a study that will involve other CD-ROM's of the same genre that are using narrative. The results from the pilot study are indicating that it might have implications for the user's experience when the basic narrative element are replaced by other elements, which do not support the process of narrative construction, by the user. The narrative is seen as fundamental for the user's experience of meaning and global coherence.(Bruner 1990; Schank 1990; Schank and Abelson J.1995) the narrative is furthermore of importance for the dimension of experience.(Gerrig 1993).

Without the narrative which affords an embedding context the user tends to experience the options offered in the interactivity as lacking in coherence and meaning. This must be seen in relation to the genre of edutainment and that the target group's users, are not supposed to have much previous knowledge about the particular field that the CD-ROM is presenting.

The study is being done in a naturalistic mode, with a high degree of ecologic validity, using natural users of the CD-ROM's with a mobile usability lab. This set up allows for a video-recording to be done with a video of the user as well as a documentation of the activity on the screen through a scan-converter. The study uses a qualitative methodology that involves user's narratives about their experiences with the program and their construction of meaning from it. Using both video-observation and qualitative interviews as well as a questionaire allows for a comparison between the different sets of data..

The focus of the project is to explore the user's experience through narrative and how it translates into a potential greater sense of motivation and possibly cognitive capability for construction of meaning, in relation to the non-linearity of the media.

The aims of the project:

- To provide a greater understanding for the qualitative aspects of narrative in relation to interactive Multimedia and the particular possibilities they offer in a learning environment in which meaning, experience and motivation are key elements.
- To explore the relationship between the contextual elements of a narrative . In particular these which are offered by the elements that constitute a beginning in a canonical narrative (Labov 1967.1997; Mandler 1984) - and the cognitive implications for the user in terms of experience, understanding and interest for the subject and motivation for further explorations into the subject.
- To look at possible connections between the narrative elements in the interactive program and the user's process of narrative construction and focus on the relationship between the narrative organization of the material and user's level of processing.(Laurillard et al. 1984, 1997)
- To explore gender specific preferences in the relation to narrativity (Gjedde 1998b) and multimedia.(Adam 1998).
- To inform the producers of educational multimedia about the implications for using narrative structure and other narrative elements in relation to specific groups.

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A Multimedia Matrix Model For Designing Instructional Strategies and Learning Experiences for Students of Human Movement Studies

Halima Goss
Teaching and Learning Support Services Department
Queensland University of Technology
Brisbane, Queensland, 4001, Australia
h.goss@qut.edu.au

Graham Kerr
School of Human Movement Studies
Queensland University of Technology
Brisbane, Queensland, 4001, Australia
g.kerr@qut.edu.au

Abstract: The aim of the current project is to design, develop and implement a teaching strategies model and a multimedia template which crosses over curricular boundaries and responds to a wide variety of learning styles of students. The Conversational Framework model as proposed by Laurillard formed a starting point in examining the place of a multimedia template in Academic Learning while the design of the template has been guided by the need to establish reusable resource materials. Key characteristics of such a template were deemed to be accessibility, cohesiveness, supportiveness, flexibility and quality.

Background

According to Laurillard, the teaching - learning process is an interaction between teacher and student operating at two intermingling levels:

Level 1 - Discursive Level - the level of theory 4 stages to reach consensus:	**Level 2 - Interactive level - the level of practice** The way the student acts in the world
1. Teacher articulates the subject matter	1. Teacher sets task
2. Student joins dialogue - asks questions, practices etc	2. Student acts
3. Teacher re-expresses their point to clarify and elaborate. * Teacher uses student understanding to adapt interactive activities and elaborate theory to those appropriate to student needs	3. World responds - includes teacher, other students, experts etc. * Teacher uses student understanding to adapt interactive activities and elaborate theory to those appropriate to student needs
4. Student has another attempt at representing the theory	4. Student modifies action to improve their performance (adaptation and reflection).

The teaching model is designed to provide a framework for the teacher and student for all steps in both levels whilst the multimedia matrix plays a role in only part of the total process. A balanced mix of multimedia resources, face to face interaction, online communication and practical activity could form the components of a complete learning experience.

Teaching Plans

It is the intent of the designers that the multimedia template act as a guiding mechanism for the teacher in order to facilitate the mapping and selection process for the teaching sequence. Through thorough analysis of the learning objectives, the resource selection, interaction planning and assessment strategies are developed and a mapping of strategies is undertaken. Once all aspects of the teaching mix are determined, then the multimedia elements are produced and assembled and supporting technologies are weaved into the virtual learning environment.

A typical analysis by a teacher in planning the learning experiences may be as follows:
* Concept Map is produced showing the interconnecting curriculum and content elements
* Identification of feasible interactions that best achieve learning outcomes
* Development of plans for each interaction eg multimedia matrix, face to face discussion, practical excursion etc
* Topic in Context material is assembled and Themes and associated Activity sequence is determined and designed
* Media Resources are gathered for supporting problem solving as required by activities
* Computer tools are assembled for use by students in carrying out activities
* Delivery proceeds with monitoring and feedback loops built in to the interactions - Evaluation data is gathered and used in review of the model and matrix.

In teaching academic staff to utilise the matrix tool, the above sequence forms the basis for a workshop. This enables the intertwining of a pedagogical and a technological focus and is punctuated by a management theme ie all three focuses become a part of the teaching plan.

The Multimedia Matrix

The matrix template consists of a number of "cells" which may be populated with content or resources which are required for the student to carry out their study of a particular topic. These are as follows:
A) Topic in Context - an overview of the topic and its place in the whole curriculum. The relevance of the topic to the profession is also a key aspect.
B) Topic resources - these are not directly linked to any one theme or activity but rather are more global to the topic eg Extended readings or digressions may be placed in the resource area
C) Themes - In order to create a single environment for students that is self contained but has interconnecting parts, the template allows for the creation of several themes. A concept map highlights the links between themes.
D) Activities - these are the problems and instructions that guide students through the resources and learning experiences designed for them.
E) Tools - These include Glossaries, Concept Map generators, Text editors, Analysis tools and a launch pad for applications that are common place such as word processors and spreadsheets.
F) Media - Video, Audio, Graphics and Text elements can be used in the template - these are dropped into any matrix and become a part of the application.

Progress to date

The use of the matrix in teaching the concepts of *movement* through the specific idea of "gait" has been planned. A plan for the main phases of teaching the sequence has been established and each matrix in a sequence multimedia support applications is being developed. These include Biomechanical, Bioenergetics, Diversity and Neurologic perspectives on gait. Rather than examining gait in each of these aspects separately, the planned sequence moves from an exploratory view through each of these perpectives in order to establish core understanding and then evolution of ideas both quantitative and qualitative from a combined view. To illustrate, a typical activity may require a student to make a series of observations that will lead to understanding of both diversity and biomechanical principles and their interrelation. Use of a common visual resource in supporting such an activity ie the same video sequence, also reinforces this cross curricular notion. The template itself is in BETA phase and has been used to assemble the first of these applications.

The staff development program that is essential in establishing the model for achieving maximum effectiveness of implementation of the Conversational Framework model has begun and a network of colleagues from one faculty group who are in close proximity, has been set up. This is a key feature for staff development in an area that requires complete rethinking and restructuring of teaching and its planning. *Collegiality and support* cannot be underestimated in their power to catalyse best practice teaching. We envisage that the notion of a learning matrix both in terms of the multimedia application itself and of the curriculum structure will provide a clearer view for both students and teachers. In this way the path through the study of a discipline may be made more transparent and flexible. In supporting a student-centred approach to teaching, the initial effort has been significant, however the revolution that will follow will show energy levels that pale these efforts into insignificance.

Being Social in an Anti-Social Environment: Is Cooperative Learning Possible Using Computer-Mediated Communication?

Joseph G. Gregg
Jones International University
United States
jgregg@international.edu

Abstract: The purpose of this study is to investigate which experiences of adult learners in an online cooperative learning environment contribute to the expected evolution from an aggregate of strangers to a group capable of high performance. There is a clear need for a thorough qualitative study focusing on the development of online relationships required for successful cooperative learning groups. . The interview, observation, and journaling methods will provide information to address impression formation, social presence, group development and the conditions of ambiguity and detraining. In addition, the results of this study will help provide a palette of best practices for designers of online learning environments utilizing similar instructional strategies.

Introduction

Providing opportunities for students to take distance education courses is becoming commonplace in higher education. It should come as no surprise that this growth fosters change and with change comes resistance and criticism. Yet, perhaps it is time to listen to that criticism. Historian David Noble, professor at York University, wrote a series of articles criticizing what he characterized as the unmindful haste by higher education institutions to adopt the Internet and World Wide Web for course delivery creating nothing more than a technologically-slick updated version of the correspondence course (summarized in Noble, 1998). Nobles' primary fear is that we are creating courses devoid of any true interaction between the student and instructor.

Course developers and instructors recognize the importance of designing interactions into courses offered by distance education means. The importance and validity of these interactions is amplified in numerous studies in which students reported that their individual success was due, in large part, to a high-level of interaction, typically learner-instructor (Eastmond, 1995; Wegerif, 1998). Likewise, many learning theorists do describe the integral role that interaction plays in the level of learning attained by students (see Reeves & Reeves, 1996, for review). Most studies on communication using computer-mediated communication (CMC) or asynchronous learning networks (ALN) have examined interactions resulting from tasks requiring some type of online discussion (Eastmond, 1995; Hiltz, 1994; Wegerif, 1998) Yet, very few studies have looked at the social aspects of group processes in online environments using cooperative learning techniques.

Reports from distance learning students in collaborative or cooperative learning groups using computer-mediated communication (CMC), specifically, asynchronous learning networks (ALN), indicate that there is a crucial moment in their experience in which they cross a threshold from outsider to insider or from newcomer to old-timer (Eastmond 1994; Wegerif, 1998). Crossing this threshold is crucial for increased positive attitude leading to continuation of the course and higher achievement. Failure to cross this threshold often results in the student dropping out of the course. How does a collection of strangers move from being an aggregate of people to a group capable of high performance using computer-mediated communication (CMC), specifically asynchronous learning networks (ALN), as the sole means of communication?

It stands to reason that understanding interpersonal communication across asynchronous learning networks is crucial to designing and implementing effective cooperative learning. Results from laboratory research led to a set of interpersonal CMC categorized as the "Cues-Filtered-Out Approach" (see Walther, 1994, for review). Essentially those theories postulated that the reduction of nonverbal cues leads to communication that is task oriented and impersonal, resulting in more equal communication among group members but the possibility of very negative interactions ('flaming'). Initially, Walther (1992) stated that the communication process observed within CMC follows that found in face-to-face groups only the time required for certain behaviors to emerge is of much longer duration. In addition, an individual's perception of anticipated future interaction with group members leads to more social relational behavior. His most recent work showed that computer-mediated communication can run the gamut from impersonal to interpersonal, and finally to what he calls hyperpersonal (Walther, 1996).

There are major discrepancies for prescriptions on how to establish and manage groups and cooperative groups, whether face-to-face or online. For example, the need for an individual to identify with the group as a prerequisite for intimacy, affection and social orientation (Bales, 1950) appears to be contrary to the identification of heterogeneous groups as the most successful for cooperative learning (Johnson, Johnson, & Holubec, 1994). Furthermore, there are conflicting theoretical approaches and even haziness in single theories about the ongoing development of thriving groups in CMC. Specifically, there are conflicting indications of how one might go about creating, facilitating, and managing online groups using cooperative learning communicating via ALN/CMC. How can these discrepancies be resolved?

Proposed Research

This study examines the key aspects to consider when using cooperative group instructional strategies for distance learning mediated by text-based Internet communication. Based on components derived from research on small group development, cooperative learning, and relational behavior, instructional strategies are recommended and a set of research questions are proposed.

Understanding the cooperative group processes when using CMC that provide for the development of successful interpersonal communication leading to close interpersonal relationships will 1) provide information for instructional designers and instructors of online courses to guide their design and 2) delivery efforts in terms of group composition, group activities, and facilitation strategies, and guide design of better interfaces and software to enhance effective communication interaction.

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Keep facilitating pupils and English teachers appropriately

Bo Han
Foreign Languages Department
National Teachers' College
Inner Mongolia P.R. China
hanbo49@hotmail.com

Abstract: This paper describes a research project on primary school English teaching and teacher training in Inner Mongolia P.R.China where the financial situations of the schools and pupils vary, and English teachers' levels differ greatly. The research group has developed a course, which has a set of kernel textbooks, and there are eight different combinations. This article describes why certain media are chosen and how they are used in order to make sure that teachers can be trained properly and the pupils can get the most possible benefit.

Introduction:

There is no doubt the use of technologies in learning is gathering pace around the world. The use of the multimedia as learning/teaching is changing the way the world thinks and acts. Multimedia has the potential to make teaching and learning more effective but can we use them everywhere? This article describes the research project on primary school English teaching and teacher training in Inner Mongolia and why certain media are chosen and how they are used. Future plan is mentioned and suggestions for improvement are longed for.

Analysis and schemes:

The demand for learning English is greater and greater in this fast developing world. This research project is aimed to meet the need of this demand. To plan for flexibility and adaptation right from the start is very important, if we aim to get good learning results for a long period of time (Griffiths, Heppell, Millwood, &Mladenova, 1994). The following aspects are what we considered when we tried to work out a proper plan:

There are not enough English teachers in Inner Mongolia. Some schools may have one; some other schools may have more. The teachers' English levels and teaching experience vary; Inner Mongolia is a region with different nationalities. The main languages are Mongolian and mandarin which have sharp differences. Mongolian pupils learn Mongolian and mandarin in primary school, so they can only learn English for one or two years in primary schools to make sure that they may not be overloaded; Some schools may have tape recorders, others may have overhead projectors. Video player, etc; locations: Inner Mongolia is a vast area. Primary schools scatter all over the area. To train all the teachers face to face is impossible; Some pupils cannot afford expensive textbooks and tapes. Some schools cannot afford expensive teaching aids; Although Inner Mongolia is a backward region, it is also changing rapidly. The numbers of English teachers in each school will change, the facilities in schools will change, the home appliances will change; How can we use different media for the pupils and teachers in the most appropriate way? (Collis & Deboer, 1998; Griffiths et al., 1994)

After all the above aspects besides teaching methodology being considered, certain media are used in the way as the following: Kernel textbooks and supplementary textbooks have been developed to make sure that the pupils who can only study one or two years may have basic knowledge of English before they go to middle schools and other pupils who have the opportunity to learn more in primary school may well informed. Eight teaching plans with scientifically related teaching materials have been designed to make sure that all the pupils can benefit most efficiently. The textbooks are designed black and white and special revision exercises are designed to make pupils paint the textbooks with colorful pencils by themselves. Therefore the textbooks not only attract pupils attention more and the pupils may remember more of the teaching materials but at the same time the price of the textbooks is cut down; Two sets of tapes are designed. One set is that one tape is offered each term to help the pupils to learn at home and to keep a low price for those pupils who cannot afford two tapes. The other set is that two tapes are offered each term. This is to make sure that there are enough feedbacks and interactive exercises to do, and it makes preview and review convenient. At the same time, these tapes can also be convenient for teachers to prepare their lessons. A special tape is designed only for teachers to check pupils assignment. In this way pupils do not have to buy that tape and teachers will not have trouble with the questions and answers. Transparent sheets for overhead projectors: Two sets of transparent sheets are designed. One is black and white; the other is with color to meet the need of different schools. In this way, teachers may have teaching aids even in schools with limited budgets. We made videotapes for pupils and teacher training so that teachers from remote areas can also have the opportunity to watch other teachers' teaching and understand the theories of teaching. Schools with video players can play the videotapes to their pupils and pupils with video players at home can watch the videotapes to learn better.

Learning should be immediate feedback as many educators have already recognized. However, the above media which have been used are quite limited in the aspect of interactive activities. This means that a lot of potentials from the teachers and pupils have not been cultivated. What should we do to accomplish our goal then? In order to work out our future plan, let's first see what will happen in this part of world in the near future?

The future plan:

In the near future more and more schools in Inner Mongolia will also have computers. Since Internet connection in China is still quite expensive, most of the families in Inner Mongolia will not be able to get an access very soon. But the perspective of using Internet in schools is great. A significant number of schools will have the capability to interact online. It means that teaching materials designed to be used with computers may help more and more teachers and pupils to teach and learn more effectively. The key to successful interactivity, is not simply offering educational access to preexisting networked materials. Rather, a more valuable role is to offer a collaborative environment where users can create, and share information of their own with other users. It's an opportunity that many teachers won't let slip by them. It means that we're reaching a point where teachers can't be competitive in other words, prepare today's children for the university and the modern workplace without the Web. Therefore, our future plan is divided into three steps:

1. To put the teachers books on Internet first and build a forum for teachers to share their teaching experience. In this way, teachers will be well informed and share their experience in teaching, and with the latest version of teachers' books, they can always try to teach their pupils better.
2. To put teaching materials with more interactive activities on CDs. In this way schools with computers and pupils with computers at home can use these materials to teach and learn more efficiently.
3. To establish on line courses for pupils to learn. Besides textbooks with interactive activities, a reading series can be developed. In this way, pupils with internet access not only can learn the textbooks well but can also learn by their own pace to develop their abilities in reading, listening , speaking and writing.

The above are our plan for the near future. We are eager to ask you the specialists in the conference to offer us suggestions in order to make this ideal into reality. All your advice would be greatly appreciated.

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Course Production Applying Object Oriented Software Engineering Techniques

Ronald Hartwig, Huberta Kritzenberger, Michael Herczeg
Institute for Multimedia and Interactive Systems
University of Luebeck
Seelandstr. 1a, D-23569 Luebeck, Germany
Hartwig <hartwig, kritzenberger, herczeg>@informatik.mu-luebeck.de

Abstract: Developers of educational material like web-based training and online courses face well known aspects of classic software development processes: Reusability of course units; Supporting cooperation and resource sharing between the members of the design process, like content authors, designers, multimedia producers and quality managers and Quality management. Therefor, software engineering techniques like object-oriented analysis (OOA) based on a central database to be used in iterative design processes will also be useful for the development of educational material. This considerations are the background for our work and experiences in the project Virtual University as described in this paper.

INTRODUCTION

The Project "Virtual University of Applied Science"

This paper reports work done in the project "Virtual University of Applied Sciences" (period of duration 1998-2003, see http://vfh.de). It aims at establishing a location independent university with a curriculum for computer science of multimedia systems and for business engineering (Bachelor, Master).The authors of this paper are involved in the production of web-based courses, in the design of user-adequate learning spaces and in the support of the design process. Their focus is on usability recommendations and quality management for the course material during the development process. Other aspects like teaching strategies, learning processes or technical issues concerning the course production are supervised by other dedicated consulting groups within this project.

Adressed Problems

During the first months of course production for the virtual university several problems got obvious:

- *The lack of a appropriate context of use description.*
  Practice showed that the developers of course material had only an incomplete mental model about the needs and abilities of the intended user groups, like previous knowledge, learning style, preferences in teaching mode, motivation and other information that would be important to adapt the teaching strategies and delivery of hypermedia structure and content accordingly (Kritzenberger 2000). The mental models about this user group and the assigned attributes even differed during development phases.
- *No stable base for the quality management*
  Quality management (e.g. of learning processes, functional correctness, usability) suffers from a lack of basic information about design and implementation requirements.
- ***Consistency of content information and re-use of contents***
  Another problem is that the content or the structure of the course units may get inconsistent during workflow. While the content author has her or his version (e.g. a linear MS-Word-Document), the hypermedia producer has to transfer content and structure to web formats (HTML and sometimes JAVA Add-Ons). Changes in the linear version have to be manually transferred to the hypermedia version. This is a source of errors and often prevents maintainance, because of the extra effort it will take. Keeping such a training unit up to date often requires to start all over again (e.g. with updating the Word-Document) and repeat former development steps.

DESCRIPTION

The main idea is to overcome the problems mentioned above by introducing a central information base which is used by all participants during the design process: content author, designer, producer and quality manager (see figure 1). Using a simple relational database combined with a powerful web frontend seems to be adequate. This database should include all the context information as well as the content of the teaching units. In a first step these informations are only presented to the involved persons but no contents are automatically generated.

For database organization object oriented techniques are used. Classes of information like "user attributes", "organisational requirements", "content", etc. are identified and then may be freely combined into "views". These views are role dependent, for example the content author may concentrate on the analysis data and the contents. Whereas the producer, who has to implement the learning unit, may need additional design rationales added by the designer. A quality manager can base his evaluation of the system on the requirements identified and documented during the analysis phase.

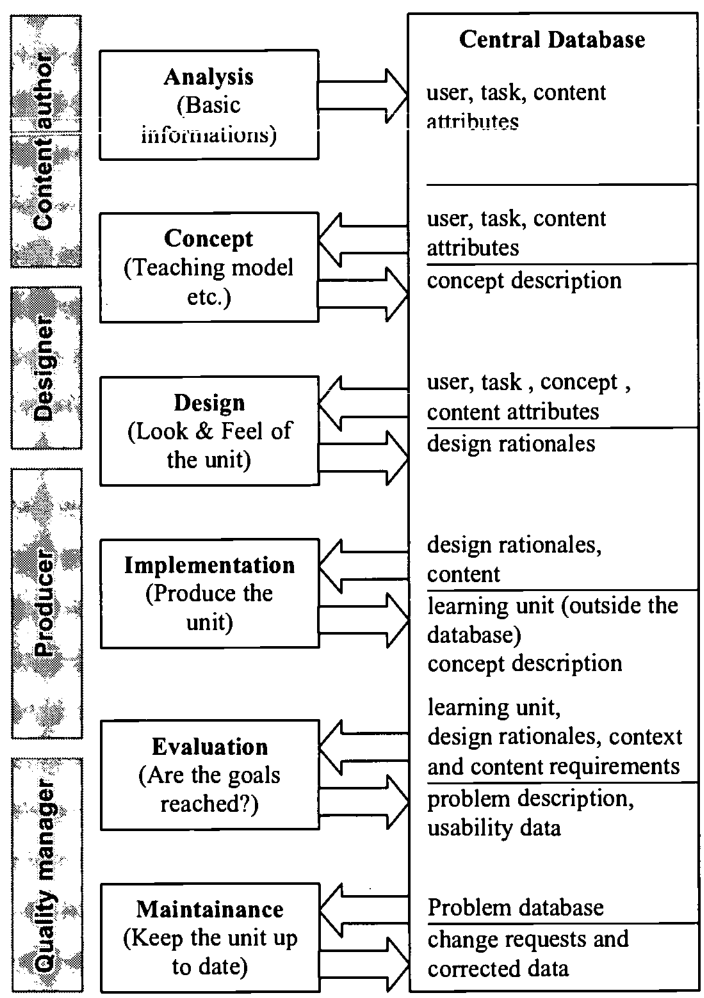

Figure 1: An iterative development process for educational systems (eg. web based training units). Please note that all these steps are to be handled iterativly, that means the whole flow must be done several times.

As the size and the number of the learning units is difficult to handle, techniques of the OOA are used: abstraction, inheritence and generalization. If for instance many different user groups are to be considered, they may be ordered hierarchically: "All users" → "users of the teaching unit" → "A special group within these user group". Attributes of the most general object ("All users") are inherited by all following objects and then, e.g. the designer's view includes all attributes, from the general to the specific ones. OOA techniques, like underspecification and refinement make the handling of large object sets easier and allow all participants to start with rather raw data and to refine them during the lifecycle of the developed system using OOA techniques based on a database has several advantages. The database supports the complete lifecycle of the course unit and makes all information and design rationales available again for maintaining or updating the course. As the contents are HTML-based they can be included into the courses with less manual effort. Furthermore, the connection of each unit to the position and role in the database is kept. nection to the database. Additionally for each production phase there is appropriate additional information available, like design rationales and the related context informations. Updating a content in the database automatically updates the course and avoids inconsistencies.

Current and future work

Currently two major tasks are to be solved: First the different object classes (content and context objects) and views needed for the educational systems must be identified, validated and implemented. Second the database tool has to be implemented and tested.

As the described method is similar to a special OOA technique currently under development in our institute as well (project "TAToo") see (Herczeg 1999), we reuse implementation resources from that project. Actually the database frontend and the needed JAVA/JDBC/JSP-Interface will be the same in both projects.

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A Framework for Evaluating the Usability of Political Web Sites: Towards Improving Cyberdemocracy

Shahizan Hassan
Department of Management Science
University of Strathclyde, Scotland, U. Kingdom
shahizan@mansci.strath.ac.uk

Feng Li, PhD
Director of Postgraduate Research, Department of Management Science
University of Strathclyde, Scotland, U. Kingdom
feng@mansci.strath.ac.uk

Abstract: In an Internet environment, users' expectations are diverse due to its on-line characteristics. Internet can be assessed by any user of any age, group, race, nationality, and gender all over the world at any time and at any place. Considering these, web site designers must adhere to certain design standards and properly evaluate their sites to ensure its usability and effectiveness. Despite abundance of studies on web usability, very few of them focus on the political web sites. Using political web sites in Malaysia as an empirical base, this research intends to identify factors affecting the use of political web sites; and then based on the analysis, develop a framework for evaluating the usability of political web sites. The main purpose is to contribute towards the improvement of cyberdemocracy in the information age.

Introduction

The central focus of the debate on the success of a democratic political system is people participation in election, political discussion, and the process of governance. In order to participate, people should possess sound knowledge about political and social issues affecting them. Traditionally, people are mostly dependent on mass media mainly newspapers, magazines, television and radio as sources of political information. Indeed, mass media has been very influential in shaping public opinion about political and social issues in any democratic country. Today, the advent of the Internet has revitalized the whole concept of communication media. Ideally, it does not only provide an alternative source of political information, but it can also be used as an effective political communication medium between and among citizens, public leaders and political parties. This development certainly provides opportunities for the enhancement of democracy whose main emphasis is on citizens' freedom to actively participate in politics by debating and exchanging views on key social and political issues.

Cyberdemocracy and Current Practice

There is little agreement on the exact definition of cyberdemocracy because of its uncommon usage. Clift (1997) states that cyberdemocracy is about the use of online communication tools for many-to-many civic discussions among citizens and public leaders. It is based on the belief that opens communication and participation is the foundation of democracy. According to Alexander and Grabbs (1998), cyberdemocracy refers to the optimized use of internet-based communication technologies by government agencies, interest groups and non-profit organizations to promote public participation in the process of governance. In general, cyberdemocracy is defined as the use of the Internet technology such as World Wide Web (WWW), File Transfer Protocols (FTP), electronic mail (email), conference facilities and net chatting for dissemination of information and exchange of ideas between and among government, political parties and public leaders with the general public. There are a number of examples of efforts carried out by government, political parties and voluntary bodies to establish cyberdemocracy. Minnesota e-democracy project (http://www.e-democracy.org), established in 1994 by a group of volunteers, held the first online debate via email among candidates for governor and United States Senate and launched the MN-POLITICS email discussion forum. Another example is United Kingdom Citizen Online Democracy (http://www.democracy.org.uk), a non-partisan effort, that began work before the 1997 national election. It hosted a number of topical events on such topics as European monetary union efforts and online delivery of government services, and it held an all-party debate during the election.

Web Usability and Research Focus

Usability is basically a very broad concept in system design and difficult to define. In this research, usability refers to how easy, effective and useful it is for a person who uses a political web site to achieve their goals. According to Nielsen and Mack (1994), and Shneiderman (1998), there are 5 main aspects of usability: ease of use, efficiency, satisfaction, rate of users' error and retention over time. The primary focus of this research will be on the usability issues of web sites used as political communication medium. These issues are grouped into seven main factors: Screen design, Content, Accessibility, Navigation, Media Use, Interactivity, Consistency -- abbreviated by the researcher as SCANMIC. These are the generic factors of web usability based on an analysis of current web design guidelines and literature.

Research Question

In an Internet environment, users' expectations are diverse due to its on-line characteristics. Internet can be assessed by any user of any age, group, race, nationality, and gender all over the world at any time and at any place. Considering these, web site designers must adhere to certain design standards and properly evaluate their sites to ensure its usability and effectiveness. Despite abundance of studies on web usability, very few of them focuses on the political web sites. Yet, usability has become one of the most important aspects that determine the success of web sites regardless of their category. With this in mind, this research will address three major questions;

a) What are factors that affect the usability of political web sites?
b) How to evaluate the usability of political parties' web sites?
c) What is the level of the usability of web sites in current cyberdemocracy efforts in Malaysia?

Conclusion

The above research questions will be used to achieve the following objectives:

a) To identify factors that affect the usability of political parties' web sites.
b) To design a framework for evaluating the usability of political web sites. The framework is designed for both technical and non-technical people who are involved in political web site development.
c) To test the applicability of proposed framework.
d) To propose a guideline for developing a usable political web site.

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Biggs' Constructive Alignment: Evaluation of a Pedagogical Model Applied to a Web Course

John Hoddinott
University of Alberta
Biological Sciences
Edmonton, Alberta, Canada, T6G 2E9
john.hoddinott@ualberta.ca

Abstract: Biggs' (1996) proposed a pedagogical model where "performances of understanding" specified in course objectives are used to systematically align teaching methods and assessment practices. The model was applied in a plant physiological ecology course delivered at a distance over the web. Students and instructor thought the course format helped learning and that the assessment model, the SOLO Taxonomy, was good. Everyone also concluded that the course workload was too great in spite of ample feedback to discourage such excess. The course may be viewed at: http://www.biology.ualberta.ca/courses.hp/bot431.hp/bot431hp.html

Evidence based good teaching practice seeks to enhance "deep learning" by emphasizing active learning strategies, high expectations, time on task, prompt feedback, respect for diverse ways of learning and student-student and instructor-student interaction. Deep learning is supported by a constructivist pedagogy that argues that it is the learner's activities that aid their construction of meaning to bring about learning.

Biggs (1996) has articulated a "Constructive Alignment" model that is the marriage of two ideas: constructivism as a framework with the learner's activities as central in creating meaning and the instructional designers emphasis on the relationship between the learning objectives and the targets for assessing student performance. In his model, the "performances of understanding" nominated in the objectives are used by the instructional designer to systematically align the teaching methods and the assessment activities.

Biggs and Collis (1982) previously developed a 'Structure of Observed Learning Outcomes (SOLO) Taxonomy' that analyzes the cognitive level of students' written work. It identifies five categories:

1) prestructural - no understanding of the topic,
2) unistructural - nominal understanding of one, or a few, points,
3) multistructural - several aspects understood but used separately,
4) relational - components integrated into coherent wholes,
5) extended abstract - the integrated whole is reconceptualized at a higher level of abstraction.

The taxonomy provides a scheme that served as a basis for giving feedback to students on their written work.

The Constructive Alignment model was applied in a distance delivered web based course for senior undergraduate and graduate students. For each week of the course, the course web site gave details of the learning objectives, required reading, optional supplemental reading and web hyperlinks to resource sites. The web site also provided an extensive background on the pedagogical principles behind the course, the nature of the SOLO Taxonomy, sample responses to a problem and their assessment according to the Taxonomy, and advice on preparing portfolios of evidence that the learning objectives had been achieved.

Students were invited to assemble their own portfolios of evidence that they had achieved the learning objectives. Portfolios were submitted by e-mail and assessment feedback was provided in the terminology of the SOLO Taxonomy. Students had access to a password protected conferencing system that allowed them to interact with each other, the teaching assistant and the instructor in a virtual, asynchronous group environment. An on-line chat room was also available through the conference system. Private communication between participants was available through e-mail.

The course opened with a telephone conference to allow the students to meet each other and interact with the teaching assistant and instructor. The students and the teaching assistant then moved to a computer lab where all students had the opportunity to demonstrate that they were familiar with the computer and software skills required to complete the course work.

Student assessment in the course was based on the submission of three portfolios of evidence of meeting the learning objectives through the term. Take home mid-term and final exams were also given. These exams were integrative of the material in the portfolios and gave the students considerable discretion in selecting the context in which the questions were answered. Exam feedback was again based on the SOLO Taxonomy. As the eight students in the course had no previous experience of distance education or portfolio assessment, they were invited to maintain a reflective journal that was read three times during the course by the instructor. Marks for keeping the journal were given on a credit/no-credit basis.

At the end of the course students were asked to evaluate the course and their learning experience. Evaluations were submitted to the TA who cut and pasted the anonymous student comments into an e-mail message to the instructor.

The evaluations showed that the students thought the course format helped learning, they developed independent learning, time management and communication technology skills, that the web materials on the SOLO Taxonomy were good, that the web material on the course philosophy was good but only in retrospect and that the learning journal material was very helpful.

In the future the students thought that workload in the course should be reduced, feedback increased, course notes provided, more texts should be placed on reserve, a lab should be included and a TA with a background in physiology would be preferable.

Students thought that future offerings of the course should retain the chat room, group camaraderie, learning objectives, the SOLO Taxonomy, and the instructor's understanding.

The instructor's evaluation concluded there should be a reduced workload, more frequent feedback, greater use of an on-line seminar facility and continued use of the SOLO Taxonomy and learning journals.

Workload was an issue for everyone. Despite the feedback given on their portfolios, the volume of evidence provided on each of the three submission dates increased steadily. Students were spending more time assembling evidence and the instructor was spending more time assessing it. Conversations in the chat room emphasized the concern that everyone shared and a phone conference was organized to discuss the problem in real time. Despite encouragement by the instructor to pay attention to the quality of the portfolio contents rather than the quantity, the problem persisted.

Providing more regular feedback would have spaced out the assessment workload for the instructor but it is not clear that it would have helped reduce the pressure the students placed on themselves to submit a large mass of evidence of their learning. The conferencing tool (WebTeach) had a seminar facility where students could have posted questions for their peers relating to the learning objectives. Responses to questions posted by their peers were not readable until participants had submitted their own answer. This facility remained unused although it might have been a vehicle to model the depth of material that was reasonable in a portfolio. It is also possible that students would see use of the seminar facility as even more work.

Everyone involved in the course was satisfied with the SOLO Taxonomy as a framework for assessment. It allowed the students to align their portfolios to the learning objectives and the assessment criteria. Students found preparing a learning journal to be useful. Evidence of concern over workload was recorded in the journals along with recognition of the feedback they were getting on what was anticipated. However, recognition of the issue and a discussion of solutions did not solve the problem.

The learning objectives were well received by the students. However, some continued to think that course notes would have helped. It seems that even these senior students were uncomfortable in assuming a large degree of control over their own learning. It is worth noting that some students commented that the material on the pedagogy behind the course was only useful "in retrospect". If these various opinions were expressed by the same set of individuals, it might suggest that more quickly coming to terms with the pedagogical background might have compensated for the lack of the course notes.

In conclusion, Biggs' pedagogical model of Constructive Alignment is suitable for application in a web environment.

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A Multimedia Resources Bank for Teaching and Learning

Vincent Hung, Jacky Pow
Centre for Learning, Teaching and Supervision
Hong Kong Institute of Education, Hong Kong
vhung@ied.edu.hk , jpow@ied.edu.hk

Winnie So
Department of Science
Hong Kong Institute of Education, Hong Kong
wiso@ied.edu.hk

Abstract: This paper introduces an attempt to make use of Information Technology to facilitate teaching and learning in a teacher education institute. A multimedia video bank was being developed to provide with teacher educators and student teachers necessary video clips that could be made use to produce computer- assisted instruction programs that fit the local context. All the videos are intentionally to do without any narration or background music to allow flexibility for the subject teachers to present their materials and to better communicate with the students.

Background

In the First Policy Address of the Chief Executive of the Hong Kong Special Administrative Region (HKSAR) Government, a firm devotion of the Government to develop information technology (IT) in education was first revealed. However the education community in HK is still striving to seek the direction of IT in education that matches the local context, a unique culture of the East and the West. Most of them, especially the primary school teachers are puzzled simply because they do not know how to start with teaching with IT.

Objective

With the aim to facilitate teaching and learning with IT that fits the local context, this project attempts to build up a multimedia resources bank (MMRB) for teacher educators and student teachers in the Hong Kong Institute of Education (a publicly-funded teacher education institute) to develop their own computer-assisted instruction (CAI) programs or to use as part of the teaching materials. It works towards a direction to encourage and promote innovative teaching approaches with an effective use of IT in classrooms.

Multimedia Resources Bank in General Studies

Despite of the resources put in acquiring computer hardware and software, there is hardly any quality interactive CAI program in "General Studies" being developed because there are difficulties facing by the primary school teachers:

[1] The heavy workload does not allow them to have location shooting and video editing that are both needed in developing the CAI programs in "General Studies".

[2] It is not worthwhile for the primary school teachers to heavily involve in video production, as it is not their profession in this aspect.

However, there are enthusiastic primary school teachers who are willing to produce their own multimedia teaching materials provided that there is enough support (Pow, So and Hung, 2000). With this in mind, we therefore tried to build a MMRB in "General Studies" for the primary schools teachers and let them to make use of the resources to tailor make their own CAI programs to facilitate teaching and learning. With the cooperation between a lecturer from Department of Science and education technology professionals from the Centre for Learning, Teaching and Supervision in Hong Kong Institute of Education, the team has produced about a hundred video clips according to the syllabus of the "General Studies" to be put on the MMRB. We chose "General Studies" as the starting point for MMRB as it is a new subject that integrates science, social study and health education in primary school curriculum, and hence at hand resources are still lacking.

The content of the video clips covers a broad area of topics from Hong Kong community services, transportation, housing, etc. to scientific experiments such as the property of magnet, heating, etc. The videos are classified, edited into a reasonable length and stored onto a video server for easy retrieval and viewing. All the videos are intentionally to do without any narration or background music since we would like to allow flexibility for the subject teachers to present their materials and to better communicate with the students. Although it is the Institute that owns the copyrights, staff and students can use it freely in their own works or teaching. Staff and students can instantly view the video clips of their choice at any computer that is linked up with the Institute's Intranet or download these media clips for their own use later on. This MMRB is expected to be able to save up valuable time and resources for those who want to try out teaching with IT but do not have enough time and resources to produce the media on their own. It is hoped that this could contribute partly to promote innovative use of IT in teaching and learning, not just within our Institute but also to the education community at large.

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The Effects of PBL Authenticity on Learning and Motivation

Myunghee Kang
Educational Technology Department
Ewha Womans University
Seoul, Korea
Mhkang@mm.ewha.ac.kr

Nari Kim
Educational Technology Department
Ewha Womans University
Seoul, Korea

Abstract: The purpose of this study is to examine the effects of learner's PBL authenticity perception on achievement and motivation. There are two major research questions. First, is there a difference on learner's achievement between high and low perception level of authenticity? Second, is there a difference on learner's motivation between high and low perception level of authenticity? The results show the following: (1) There is a significant difference in the learner's achievement between low and high level of authenticity perception ($t=-3.42$, $p<.05$) (2) There is a significant difference in learner's motivation ($t=-3.34$, $p<.05$).

Introduction

In recent years, with the advent of the Information Society, the focus of educational paradigm has been shifting from "teaching" to "learning". This signifies a move to a learner-centered education where the student becomes an active participant in the learning process. Korea's educational reform committee has established a goal to build a learner-centered educational environment to prepare Korea's students to be competitive in 21st century.

"Web's Cool" program has been planned since 1998 to support the learner-centered education system in Korea. Subject areas such as language arts, math, science and ESL(English as a Second Language) for middle school students have been developed on the Web. Since the Web was considered to be an effective medium for learner-centered approach by applying the constructivistic principles, PBL(Problem Based Learning) strategy were applied to provide students opportunities to participate in the learning process actively.

While the Web's Cool has been developed, we wanted to investigate the fact that whether the problem we were using as an authentic task has any effect on learner's motivation and achievement. In order to measure the authenticity of the task, the expert's as well as student's perception level of the authenticity toward the task has been scored by using a 5 point scale. Two tasks were selected as high and low authenticity level of perception by both 10 experts and 10 students to investigate the effects.

The purpose of this study is to examine the effects of the authenticity perception on learner's motivation and achievement. There are two major research problems. First, is there a difference on learner's motivation between high and low perception level of authenticity? Second, is there a difference on learner's achievement between high and low perception level of authenticity?

Research Method

Subjects

Subjects for this study are 51 students of the middle school students. Two learning tasks perceived low and high authenticity are selected.

Results

The results are as follows:

(1) There is a significant difference in the learner's achievement in general between low and high level of authenticity perception ($t=-3.42$, $p< .05$). A significant difference was found in the learner's authentic achievement between low and high level of authenticity perception ($t=-4.54$, $p< .05$). However, no significant difference was found in the learner's logical achievement between low and high level of authenticity perception ($t=-1.75$, $p< .05$).

Achievement	Authenticity perception level	Mean	SD	t	p
Authentic Achievement	High	1.58	.77	-4.54*	.00
	Low	1.05	.88		
Logical Achievement	High	1.69	1.01	-1.75	.09
	Low	1.34	1.03		
Total Achievement	High	3.27	1.56	-3.42*	.00
	Low	2.42	1.99		

(* : p < .05)

(2) There is a significant difference in learner's motivation of a total ($t=-3.34$, $p<.05$), attention($t=-3.16$, $p<.05$), relevance($t=-2.55$, $p<.05$), confidence($t=-2.85$, $p<.05$) and satisfaction($t=-2.34$, $p<.05$) between low and high level of authenticity perception.

Motivation	Authenticity perception level	Mean	SD	t	p
Attention	High	3.68	.57	-3.16*	.003
	Low	3.44	.52		
Relevance	High	3.64	.50	-2.55*	.014
	Low	3.47	.53		
Confidence	High	3.47	.42	-2.85*	.006
	Low	3.29	.41		
Satisfaction	High	3.40	.46	-2.34*	.023
	Low	3.25	.45		
Total	High	3.45	.42	-3.34*	.001
	Low	3.27	.40		

(* : p < .05)

Conclusions

Based on the results of the study, following suggestions were made: (1) Measuring scale of authenticity of the learning task has to be further validated through many different situations and various subjects (2) Authentic assessment of the authentic learning environment has to be studied further.

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Teaching WAP Technology as a Part of a Multimedia Course

Harri Keiho, Jari Lahti, Jari Multisilta
Tampere University of Technology, Information Technology, Pori
P.O. Box 300, FIN-28101
Pohjoisranta 11
FIN-28101 Pori,
{harri.keiho;jari.lahti,jari.multisilta}@pori.tut.fi

Abstract: Wireless Application Protocol (WAP) provides a universal open standard for bringing Internet and Intranet content and advanced Value Added Services to mobile phones, PDA's and other wireless devices [1]. The production of WAP applications and content requires new software professionals on the area. In this paper we describe our experiences from the multimedia course where students developed WAP applications as their project work[5].

Background

WAP is an industry standard whose purpose is to achieve universal mobile access to Internet based information services. The application is independent of the underlying digital wireless network technology [1]. WAP applications are developed with Wireless Markup Language (WML) and WML Script. [2]. WML applications can be developed with special toolkits, for example Nokia WAP Development Toolkit , Ericsson WAP development kit or UP.PHONE development environment . These toolkits include smart editors and debuggers, phone simulators and help system. However, its is possible to develop your WML applications using only a simple ASCII editor. The students developed simple WAP applications in the laboratory work and implemented a larger project work in the end of the course.

Wireless Markup Language Specification and WML Script

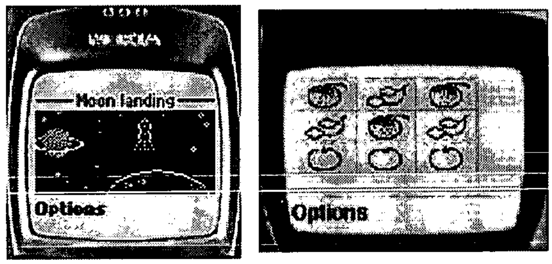
The Wireless Markup Language specification describes the markup language, WML, including the document semantics, Document Type Definition (DTD), and encoding extensions. WML is a markup language based on Extended Markup Language (XML) and is intended for use in specifying content and user interfaces for narrowband devices, including cellular phones and pagers. All information in WML is organized into a collection of cards and decks [3]. WML Script is a scripting language that makes it possible to implement dynamical elements in the WML application.

Student's WAP projects

The students were required to design and implement a real WAP software and document the code in the end of the course. The topic of the project was free and many of the students chose to implement a game in WAP phone. In this chapter we will present three WAP games, namely Moonlanding game, Lucky Wheel, and Jackpot. The idea of the Moonlanding game is to land to the surface of the moon by controlling the fuel consumption of the rocket (Fig. 3). In the Lucky Wheel game your mission is to find out a secret word or words by guessing the missing characters. Jackpot is the WAP implementation of the old casino game (Fig. 3). Some of these applications are being developed furthermore and will be published in the commercial WAP service by the national mobile phone operator.

The first step in the project was the learning of the WAP development environment. The Nokia Wap software toolkit was used in the projects. In general, programming in WML and WMLS is similar than programming in almost any other environment. It is possible to use the toolkit as a stand-alone environment or with Nokia WAP gateway in order to simulate real wireless connections [6]. In our case, it was not required for the students to test their software in real phones. During the development of their software the students find out several problems. One of the most significant problem was the differences between the real phone and the simulated phone. Of course the toolkit itself was beta-level software and was not very reliable. In addition the real WAP phone does not fullfill the WAP specification [4]. For example, the Nokia 7110 WAP phone does not support table feature in the WML content and the WAP applications can use only a little memory - the memory size in the phone is appx. 2 KB.

Figure 3. The moonlanding game and the Jackpot.



Positive aspects in the project were that the project was very motivating, the simulator makes it possible to develop software without the real phone, it was easy to learn to program with WML and WMLS because they are similar than HTML and JavaScript and students used actively WAP discussion groups in internet.

Conclusions

Increasing global competition, digitalization of content the general use of HTML and WML languages and the adoption of mobile broadband data transfer will require software specialists with new skills. In the future content producers, telecommunication companies, IT companies and media companies need workers with good knowledge technological convergence and good ability to use the new content producing technologies like WAP. This is a demand for the educational institutes and universities. We should provide up-to-date technological education and be prepared to modify our curriculum to follow the latest technological innovations. In this paper we have discussed about WAP as a new technology to implement wireless content services. The students at Tampere University of Technology studied the WAP technology and implemented simple WAP applications as their project work. The applications were developed using freely downloadable Nokia WAP development toolkit. The most significant problem was the differencies between the real WAP phone and the simulated WAP phone. From our point of view the projects succeeded well: some of these applications are being developed furthermore and will be published in the commercial WAP service by the national mobile phone operator.

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Enhancing Total Patient Management Skills in Dentistry with Interactive Multimedia Simulation

Mike Keppell
Biomedical Multimedia Unit, Faculty of Medicine, Dentistry & Health Sciences
The University of Melbourne, Australia
e-mail: m.keppell@medicine.unimelb.edu.au
Karen Kan & Louise Brearley Messer
School of Dental Science, The Faculty of Medicine, Dentistry & Health Sciences
University of Melbourne, Australia
e-mail: k.kan@dent.unimelb.edu.au, l.messer@dent.unimelb.edu.au

This paper examines a project which aims to improve dental clinical management through case management of medically compromised dental patients. During the past few years, it has become increasingly difficult to access suitable patients, especially child patients, for dental students and consequently for them to become sufficiently experienced in treating patients with medical conditions. Multimedia simulation provides a means to fill this gap and allows interactive learning in a non-threatening environment. This paper examines the design, development, project management and evaluation of the first module – congenital heart disease.

Teaching dental students to treat patients safely and efficiently presents many challenges. The declining availability of suitable patients attending the teaching clinics of the Royal Dental Hospital of Melbourne prevents students from developing a range of experiences in total patient management. A disadvantage of traditional preclinical laboratory teaching is that students are not able to integrate theoretical and practical skills. Consequently there are concerns that dental students are not competent in combining preventive and restorative management philosophies while integrating diagnosis and treatment planning (Suvinen, Messer, Franco, 1998). Multimedia case simulations were considered to be a viable alternative as they replicate the dental clinic without requiring 'live' patients. These modules provide an opportunity to develop and consolidate the concept of integrated patient care.

During 1999 the first module, congenital heart disease (CHD) was designed and completed. During 2000 further funding will allow three other modules to be developed: diabetes, Down syndrome and cleft lip and palate. These medical conditions were chosen as they are the most likely medical conditions to be encountered and are least understood by a dentist in general practice treating children. Each condition will follow the existing template developed for the CHD module except for the diabetes module which will use a 3-D Dental surgery to enhance interactivity. The CHD module contains a description and review of the medical condition, considerations of medical management and dental management. The student is then presented with a case scenario of a child with CHD. The student constructs a treatment plan and management approach after considering a range of treatment options. The module series will replace some tutorial and lecture content for both 4th and 5th final year dental students. The modules will not replace valuable clinical practice; but prior learning from the modules will enhance students' ability to perform clinical work. The modules will also be used for post-graduate students and in Continuing Dental Education programs for dentists.

Design and Development

In designing and developing the CHD module, the project team followed the model utilised by the Biomedical Multimedia Unit (Keppell, 1998). The design phase of the project focussed on developing the macro-structure for the module in the form of a concept map (Novak & Gowin, 1984) and completing the micro-structure in the form of a 'planning grid'. The content experts for the project were experienced specialists and educators in the field of paediatric dentistry. They worked with the instructional designer to develop the concept map and planning grids for the project. **Figure 1** http://www.medfac.unimelb.edu.au/Ed-Media2000/ outlines the resultant concept map which provided a scaffold for the development of the planning grids. The process used to develop the concept map and planning grids followed the Content Production Process (Keppell, 1999). A specific form of storyboard or 'planning grid' has been developed to provide a 'communication tool' for interfacing between the instructional designer, content expert and graphic designer/programmer (Keppell & Buschgens, 1995). The planning grid is useful in streamlining communication and providing a common ground for discussing the multimedia project. The planning grid is analogous to an 'architectural blueprint', which can be applied or 'engineered' by the graphic designer/programmer (see **Figure 2** http://www.medfac.unimelb.edu.au/Ed-Media2000/). The graphic designers developed the interface for the congenital heart disease module and the subsequent modules (see **Figure 3**. http://www.medfac.unimelb.edu.au/Ed-Media2000/)

Project Management & Evaluation

The project management focussed on carefully scoping the project, providing a detailed planning grid to the graphic designer/programmer and establishing the "look and feel" of the interface. England and Finney (1999) suggest that each project will define its "own quality priorities" (p.17). In this project the priorities of target audience, subject, budget and the time available impacted on the project management of the project. England and Finney (1999) also suggest that "design quality for media projects = content and treatment agreement" (p.17). These treatment parameters were carefully considered in the initial stages of the project conceptualisation. The first module was targeted to be completed within an hour by undergraduate users. The macrostructure for integrating the subsequent modules was also considered as an essential characteristic of the project. In order to analyse project costs and as a means to plan for the future modules, the total work hours were tracked for this module. A total of 390 hours was required to produce the CHD module (see **Table 1** http://www.medfac.unimelb.edu.au/Ed-Media2000/). The CHD module was completed in November, 1999 and was evaluated with a group of 15 recent graduates (interns and postgraduate students) at the School of Dental Science in December 1999, using a Likert-style questionnaire. **Table 2** http://www.medfac.unimelb.edu.au/Ed-Media2000/ shows the distribution of responses to questions concerning content. The majority of all responses were either "strongly agree" or "agree", with most modal responses being "strongly agree" (**Table 3**). http://www.medfac.unimelb.edu.au/Ed-Media2000/ Most respondents correctly identified the deliberately placed distractor, "confusing". In general appraisal, the majority of respondents rated the module as "good" or "excellent", and "very easy" to operate and navigate (**Table 4**). http://www.medfac.unimelb.edu.au/Ed-Media2000/ Of interest, one respondent rated the module "very poor" and "difficult" on these points. The module is currently undergoing beta testing at three national and three international locations, in departments of pediatric dentistry.

Discussion

Computer-assisted education in dentistry is in its early stages (Yip and Barnes, 1999). Developments are occurring very rapidly, and educators must evaluate modules developed internally or purchased externally (Mercer and Ralph, 1998). Sound instructional design indicates the goals of instruction must be made clear, so that users know what is expected of them in operating and navigating a module. This may not have been so in the instance of one respondent. Nonetheless, it is concluded that computer assisted instruction was enthusiastically received by most of the recent graduates. Experience in focus groups has shown that participants valued the tutor discussions that were held at the end of the module, which allowed extension of learning and further professional role-modelling.

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Using Electronic Portfolios to Demonstrate Beginning Teacher Competencies

Karen Kortecamp
George Washington University
2134 G Street, NW
Washington, DC 20052
karenkor@gwu.edu

Libby Hall
George Washington University
lhall@gwu.edu

Burcu Tunca
George Washington University
btunca@gwu.edu

Abstract: At the George Washington University teacher candidates in the master's program learn to apply technology in teaching and learning within the context of methods and curriculum courses and school-based practicum and internships. Teacher candidates acquire skills and understanding as they prepare presentations, develop curriculum materials, teach lessons, assess student learning, and reflect on practice. This short paper describes the ways in which teacher candidates' development of multimedia electronic portfolios to assess their ability to implement a variety of instructional models assists in learning to use a variety of hardware and software for instructional purposes. It is expected that teacher candidates will, on some level, transfer their proficiency in using technology to the secondary students with whom they work during their teaching internships.

Why Electronic Portfolios?

Performance assessment in teacher education programs commonly includes development of a teaching portfolio during the teacher internship. The purposes of the portfolio are to document professional growth (Campbell, et. al. 2000) and to cultivate outstanding teaching and learning (Wolf, 1996). Fulfilling these purposes requires that the portfolio is a dynamic, flexible documentation of student growth. Emerging technologies facilitate creating electronic portfolios that support flexibility rather than traditional portfolios constructed in 3-ring binders that tend to be collections of artifacts. The electronic format offers several advantages: the ease of storage usually on a computer hard drive or some sort of removable media (floppy disk, Zip disk, CD); easy access to information; portability is enhanced; multiple copies can be created at low cost; the opportunity to add sound, pictures, graphics, and even video make an electronic portfolio more attractive and interactive than traditional style binders; in the process of developing portfolios, students gain valuable technology skills as they create and edit this multimedia document. These skills can be transferred to 6-12 students during the internship and as the successful teacher candidate moves into classroom teaching.

Development of the Electronic Portfolio

A group of teacher candidates in the secondary education graduate program at The George Washington University are expanding their technology proficiencies through developing an electronic portfolio. The primary purpose is to provide teacher candidates with technology related skills that they can transfer to middle and high school students and use to support their teaching. A secondary purpose is to enable teacher candidates to demonstrate their teaching competencies using an alternative method to the binder-style portfolio currently in use in many teacher preparation programs.

The conceptual framework used to develop the portfolios is based on the Interstate New Teacher Assessment and Support Consortium Standards (Darling-Hammond, 1992) and the National Board for Professional Teaching Standards (1991). The domains addressed include: 1) commitment to students and their learning, 2) knowledge of the subjects taught and how to teach those subjects to students, 3) establishment and management of student learning in a positive environment, 4) assessment of student progress and adapting instruction to improve student learning, 5) commitment to reflective practices, and 6) professionalism. Several indicators are provided to students within each domain specifying ways in which each is exemplified in teaching or in course work.

Those participating are currently enrolled (spring 2000) in a class that teaches application of instructional and classroom management models. The instructional models reviewed include Direct Instruction, Inductive, Inquiry, Integrative, and Cooperative Learning. Each of the models represents a cognitive perspective of learning which views learners as active investigators of their environment. In these models, teachers are directly involved in guiding learning through questioning and discussion. Candidates construct a number of products to show their understanding of concepts and theory and their ability to apply them in a teaching-learning situation.

Specifically, teacher candidates learn how to use various technologies as they learn pedagogy. In the course, they will practice using technology to: present information; research content; organize and store data; track and record their development as teachers; and reflect on their teaching behaviors as a process for solving problems and growing professionally. For example, they will learn to use PowerPoint in the context of learning how Howard Gardner's Theory of Multiple Intelligences applies to the teaching of science, math, English, social studies or ESL. Each candidate will design a presentation that outlines how each of the 8 intelligences is used to frame curriculum development of a specific unit topic. Candidates select topics according to their content specialization. Each will focus on the utility of the theory in: 1) designing curriculum, 2) engaging and motivating students, and as 3) assessing students' learning.

In demonstrating their understanding of and ability to apply instructional models, candidates will teach lessons they develop to other members of the class. They will be videotaped using a digital video camera. After receiving feedback from peers and the course instructor, the teacher candidates will view the video and reflect on the effectiveness of their teaching. As a part of the reflective process, they will edit their video to capture those portions that exemplify what they have learned about their teaching and will include this shortened version in the electronic portfolio. In the process of creating the portfolio, teacher candidates will learn how to create a personal website. The goal is to expand their portfolios as they move through the graduate program. Unlike what typically occurs in the binder approach to portfolios in which students organize a collection of artifacts during the teaching internship which illustrate their best work, the approach taken here will concentrate on documenting growth as teacher candidates develop their knowledge and skills in both pedagogy and content. This means that candidates will begin assembling their work during their initial experiences in the program and, the work included in the portfolio will not necessarily showcase their best products. Rather, the final product will reveal the ways and extent to which each candidate has grown as a beginning teacher.

Conclusion

One major area of emphasis in the teacher preparation program at the George Washington University is to prepare teachers who will serve as leaders in the schools where they teach. An important aspect of that leadership role is technology. As our students develop their proficiency in this area, they will be encouraged to explore the connections to teaching in middle or high school. The ways in which technology use can enhance teaching and learning is of particular importance. Specifically, through the development of electronic portfolios, these teacher candidates will consider how the use of technology can assist secondary level students in: learning content; presenting information; conducting research; and, reflecting on their development as learners.

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Prospects and Limits of Conceptual Models for WBT Course Production

Huberta Kritzenberger, Jürgen de Wall, Michael Herczeg
Institute for Multimedia and Interactive Systems
University of Luebeck
Seelandstr. 1a, D-23569 Luebeck, Germany
Phone: +49-451-3909-506
{kritzenberger, dewall, herczeg}@imis.mu-luebeck.de

Abstract: This paper is based on experiences with the production of web-based training (WBT) courses for a course of studies in medical computer science. Course production is regarded as software development process, which starts with conceptual models shaping the design and defining the way the software product is presented to the user. This paper reports experiences with conceptual design models and shows the danger of being insufficient or incorrect.

INTRODUCTION

Our project "Distance Education in Medical Computer Science" (started in January 1999) aims at providing a complete course of studies for the specialization of students in medical computer science, offered at a virtual university. Our responsibility is to transfer the linear text documents (mostly MS-Word format) into hypermedia networks and multimedia courses, which means practicing reverse engineering for WBT course development.

PROBLEMS WITH CONCEPTUALIZING WBT COURSES

The transfer of a text document to hypermedia means transformation of format, gain of flexibility, interaction capabilities and so on. Hypermedia and multimedia courses can be used in ways beyond the intentions of the content author. On the other side, people occupying other roles in the development process, like multimedia designers, or quality managers do not know about the content domain or didactic aspects. The static version, which the content author had in mind, has only one dimension of presentation. Accordingly, the semantic (content) structure and the didactic structure of the course are intertwined. Most authors are not able to separate both structures in a way applicable for hypermedia production and vice versa the multimedia experts are normally no experts in the semantic domain or in didactics, therefore, they can hardly explain their needs to the content authors. This lack of knowledge in each others domain results in unintended course structures, unnecessary restrictions or other mismatches. A similar problem arises if the author for example has to start with specifying a semantic model and then would have to design for different learner groups.

Furthermore, we found in our projects, that media designers, producers, and content authors often have insufficient, incomplete, and partly incorrect models about the learners, the task and the situation of use. The models vary at different times during the period of course production.

COURSE PRODUCTION AS SOFTWARE DEVELOPMENT PROCESS

Our approach to course production as practised in our projects is to regard the production of hypermedia and multimedia WBT courses as a software development process. As for many other software systems, it is also true for the development of WBT courses: To realize a user and task adequate human-computer-system, developers have to take into consideration all system components: user, task and situation in order to form a conceptual model that is as adequate as possible [1]. The conceptual model of the developers shape the software product, in our case the WBT course, and therefore, will decide how usable and user-friendly the WBT course will be and how adequately it will support learning processes.

Figure 1 shows the different models we have to deal with in the context of WBT course production. First of all there is the developer's mental model the design process starts with. In the case of WBT course development we have to deal with diverse developers. In our project there is the conceptual models of the content author, of the designer, of the HT/MM producer and of the quality manager. Furthermore, there is the learner's mental model about the application domain, how the WBT course is implemented and how it supports learning processes. And last but not least, there is the system's model, which contains the way the application domain is implemented and sometimes information on the user's interaction with the system. Each model represents the complex domain of interaction with WBT courses from a certain perspective and in a specific way.

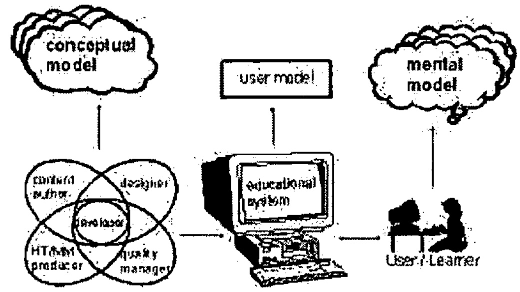

Figure 1 : Models in the context of WBT course production

Mismatches between these models lead to usability problems of the software product. Above all, the importance of the developer's conceptual model for shaping the software product has been noticed for other kinds of software applications for a long time [2], [3]. According to our view, this holds true for WBT courses as well.

CONCEPTUAL MODELS OF DEVELOPERS

A fundamental problem for the development process is, that the developers need substantial and relevant information about the user, the task and the situation of use. They need this information from the very beginning of the design process in order to specify the requirements and shape the WBT course adequately. However, in practice content authors start course production in the traditional way and produce a linear document that includes their conceptual model about domain knowledge and about teaching strategies. This production methods corresponds to the production of traditional lectures for classroom teaching. These courses will not match the situation of use in the virtual university of the future. Lectures on demand have to serve the needs of different user groups and different situations of use. The attributes for users, the task and the situation of use will differ [4] and should have an adequate representation in the conceptual model of all authors. A severe drawback with this situation is, that it is impossible for a content author (and also for the other developers) to take into consideration all these attributes at one time.

In some way, of course, the author is aware of the situations of use and the complexity involved. This might be the reason, why the conceptual model about the user group and the assigned attributes differ from phase to phase of the development process. This is a problem as well. If the conceptual model of the developers includes a prospective mental model of the user and if the design is based on this model, then it will be clear that varying the conceptual model during the development process will result in an inconsistent WBT course, which will be hard to understand and will not support learning processes.

FUTURE WORK

The conceptual models of the diverse developers shape the WBT course and determines the way the educational system is presented to the user and determines if it supports learning processes. Therefore, it is important for the developers to have sufficient and appropriate knowledge about the user, the task and the situation and it is also important that the conceptual models of the diverse authors can be communicated and complement each other during the design process.

With this background we are working on methods to adequately represent conceptual knowledge for the design process [5]. We also want to offer ways to communicate relevant knowledge components between all developers through the whole development process.

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Students' Acceptance of Videoconferencing in the Lecture Context

Patrick Kunz
Network for Educational Technology NET
Swiss Federal Institute of Technology (ETH)
Zürich, Switzerland
kunz@diz.ethz.ch

Abstract: The goal of this work was to develop a set of recommendations for the use of videoconferencing in large classrooms. The students' acceptance of synchronous videoconferencing, the role of the instructors as wcll as the influence of videoconferencing on motivation and interactivity were in the focus of this study.
Based on the statements of 178 evaluated students there are three main recommendations that can be made: (1) The didactic approach of the course must concentrate on an more active involvement of the participants. (2) The instructor must be willing to adapt his teaching style to the integration of new media. (3) Technic has to be so perfect, that it guarantees the first two aspects: an undisturbed transmission with possibilities to interact for all participants and support of the instructor to make teaching easy.

Introduction

A lot of studies report about the benefits of videoconferencing in the context of small classes with active student participation. Videoconferencing in small classes has been shown to increase student motivation as well as interaction among students and lecturers often leading to a redefinition of teaching (among others Abotte, Dallat, Livingston, & Robinson, 1994; Bramble & Martin, 1995). Experiences with videoconferencing in the large classroom context however differ at least in part in some of these results. Increased inhibition to speak in front of others and lowered spontaneity seemed to be real problems (Knox, 1997). Further, an improved motivation or satisfaction was not found (Fillion, Limayen, & Bouchard, 1999). The purpose of this study was to find out, which aspects are the most crucial for the use of videoconferencing in large classrooms.

Method

Equipement

The videoconferencing facility used in this evaluation is a synchronous system based on ATM. Its theoretical bandwidth of up to 155 Mbits/s allows the simultaneous transmission of three audio- and video-streams with high quality and perfect audio-video synchronisation between two and more connected sites. The system provides full interaction possibilities to all participants at all connected sites.
The setting in the examined lecture is a two-point configuration consisting of the following components:
Remote classroom: Three screens, projected by beamers, with 1.) the instructor, 2.) the PowerPoint slides and 3.) the other class.
Local classroom: Two screens, projected by beamers, with 1.) the PowerPoint slides and 2.) the remote class. For further technical details see (Walter & Hänni, 1998).

Participants

The examined sample consisted of totally 178 participants of a two year course in pharmaceutical chemistry (86 students in the locat classroom; 92 students in the remote classroom). Gender representation was not equal (139 female and 39 male).
Control data (normal course without videoconference) were collected from students of both locations during summer 1999. The experimental data resulted from the first half (13 weeks) of the academic year 1999/2000.
The constructs and its components consisted of items which were measured using a five-point Likert-type scale (1=strongly disagree to 5=strongly agree).

Results and discussion

The following presented results were based on a minimum level of significance of $p<0.001$.

Acceptance and Motivation

As expected, students in the local classroom accepted with M=3.3 the videoconference better than remote students (M=2.7). Furthermore there was a significant difference in the acceptance which is correlated with the infrastructure: While in location 1 the auditorium used for the transmission consisted of a permanent equipped room, location 2 had to build up all equipment for the lecture every week.

In contrast to studies who reported about increased motivation, the measured motivation construct (consisting of subject interest and self-efficacy) remained the same with versus without videoconference. Nevertheless, with r=0.57, motivation was one of the strongest predictor of the acceptance.

Influence of the quality of the transmission

The participants rated the quality of audio (M=3.9), the level of synchronisation (M=3.7) as well as the quality of the transmitted videos (picture of the lecturer (M=3.8) and projection of the slides (M=4.1)) more than satisfying. Only the video of the remote auditorium was assessed average (M=2.9). The quality of transmission seems to be so good, that there were no correlations greater than r=.34 with the acceptance or the motivation.

Role of interactivity

The largest impact on the acceptance of a videoconference-classroom exerted the possibilities of interaction. Students assessed this kind of lecture in comparison with a normal classroom less stimulating for discussions between them and the lecturer (M=2.5). This variable had with r=.61 thew strongest correlation with acceptance.

The hypothesis, that students were more inhibited to ask questions during the class, can be accepted. However, the level of inhibition was lower than expected (M=3.5). With r=-.27 ($p<0.002$) the correlation between inhibition and acceptance never reached the expected level.

The possibilities of spontaneous intervention were even rated slightly higher than in the traditional classroom setting (M=3.2) and did not coincide with the students' actual hesitance. This high rating is most likely due to the lecturers' efforts to integrate prepared questions in their slides. Its correlation of r=.43 with the acceptance underlined the importance of the possibility to interrupt the speaker at any time.

Role of the instructors

The correlation of r=.38 between the acceptance of videoconferencing and the performance rating of the lecturers (with M=3.6 both were assessed above average) emphasized the important role of the instructors.

It is encouraging to note, that the implementation of videoconferencing had positive side effects on teaching: The cooperation of the two involved professors lead to an overall improvement of the curriculum with better structure, more goal orientation and the integration of prepared questions.

Recommendations

Based on these results, the following guidelines are proposed for the use of videoconference systems in the lecture context with groups consisting of more than 20 participants on each side:

1.) Lecturers have to consciously plan possibilities to interfere and to create an atmosphere that motivates students to undertake a more active part.

2.) The instructor must be above average and be willing to accomplish an extra effort.

3.) The technical infrastructure must guarantee a clear transmission of video and audio as well as the possibility of interaction at anytime for all participants.

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Understanding collaborative learning in CMC: A research in an elementary classroom

Qing Li, University of Toronto, Canada

Abstract: This study is intended to understand collaborative learning in a context that enables communication by computer text messaging. Particularly, the study seeks to determine the level of collaboration in a classroom that uses computer-mediated communication (CMC), as well as to examine the relationship between the language functions associated with CMC generated messages and the collaborative learning process. In this study, "language functions refer to ways we can use language to achieve a communicative purpose" (Olsen, 1992). It is what people "can do with language" (McDonell, 1992), or "what people want to do with the language" (Finocchiaro & Brumfit, 1983, p.13), such as: requesting information, requesting confirmation, making suggestion, apologizing, etc.

The study is prompted by following questions

1. What are the levels of collaboration (in terms of interactivity) in the classroom that uses CMC?
2. Are there any patterns in people using of language functions in relation to the degree of collaboration (in terms of interactivity) in the context of CMC? If yes, what are the patterns?
   a). Are there any patterns in people using "requesting information" in relation to the degree of their collaboration (in terms of interactivity)?
   b). Are there any patterns in people using "requesting confirmation" in relation to the degree of their collaboration (in terms of interactivity)?

Computer-mediated communication (CMC), is an effective electronic means of connecting geographically dispersed learners using computers, in order that they may collectively participate in a learning experience where the interaction is mediated. Despite it relatively short history as a distance medium, a great deal of interest has been shown in this technology.

Courses offered by CMC are gaining favor in schools and institutions of higher education. Students can interact at a time and in a place that is personally convenient, discuss issues as fully as desired without constraints (Henri, 1995). CMC promotes interactive activities such as active dialogue and sharing of information and knowledge, which help develop a sense of community among participants (Burge, 1993). The CMC can be used as a powerful tool for group communication and collaborative learning (Crook, 1995). The collaborative learning environment promotes active mental engagement in the experience (Grabowski, 1990).

Despite the large body of literature on peer learning and teaching, there are few acknowledgments of how well CMC may support collaborative learning. Although cognitive and social psychology have already provided much information about how students communicate and its relationship with collaborative learning, the context has usually been the traditional face-to-face setting with its paralinguistic cues to facilitate communication. What we do not yet know in published detail are how people learn collaboratively and how this collaborative learning relates to the communication in the CMC context. In addition, O'Malley (1995) calls for studies of collaborative learning that "focus more on the processes involved in successful peer interaction, rather than just on learning outcomes".

Therefore, this study seeks to understand how people learn collaboratively and how their collaborative learning relates to the communication in the context of CMC. By asking these research questions, I assume that if we, as educators, know more about the process of collaborative learning in a computer-mediated-communication environment, we have a better chance of developing practical guidelines for facilitating learning. In addition, the information obtained from the study may contribute to the present understanding of students learning in CMC environment and may suggest future studies in the area.

For instance, numerous studies (Johnson & Johnson, 1989) dealing with collaborative learning have suggested that students need appropriate social skills in order to be successful in their collaborative learning. Johnson and Johnson (1989) emphasize that collaboration is the most important and basic form of human interaction, and the skills of collaborating successfully are the most important skills anyone needs to master. Coelho (1992) explains that good social skills can promote collaborative learning and some negative behaviors can shut off future collaboration. In addition, the literature on collaborative learning emphasizes the need to teach social skills. Students need assistance in acquiring those social skills and many of these social skills can be regarded as communication skills. For example, Olsen and Kagan (1992) state that "social skills include ways students interact with each other to achieve activity or task objectives (e.g., asking and explaining) and ways students interact as teammates (e.g., praising and recognizing)".

However, all these conclusions are based on the works that have been done in traditional face-to-face settings. Are the conclusions still true in the CMC environment? This remains to be answered and it raises important questions in the field of collaborative learning. This study will try to understand how students go about communicating and learning in the CMC environment. Once we have this understanding, we might then compare the CMC learning strategies with those reported for face-to-face classroom contexts in order to search for new practices to facilitate collaborative learning and better suited to the CMC context. And only when we have a better understanding of computer mediated learning, we can make a better use of CMC.

The subject of this study will be a grade 5-6 classroom in an inner elementary school in Toronto.

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Combining Instructional Models and Enabling Technologies to Embed Best Practices in Course Instructional Design

Paul M. Malone, Germanic and Slavic Languages, pmalone@artsmail.uwaterloo.ca
Catherine F. Schryer, English Department, cschryer@watarts.uwaterloo.ca
Vivian Rossner-Merrill, Lt3 Centre, vrmerrill@lt3.uwaterloo.ca
University of Waterloo, Ontario, Canada

Introduction and Overview

Two distinct fields of educational activity should inform instructional design of courses using teaching technologies. These are cognitive theory and instructional theory. Cognitive psychologists tend to analyze cognitive structures and processes at a conceptual level without due regard to how these may be implemented in the instructional setting. Conversely, content designers and instructors do not often recognize the value of undertaking the analysis of content and teaching practices from a cognitive analytic perspective (Reusser, 1993). We propose that one means to combine the best practices of both fields in teaching and learning is to ensure that the instructional design process integrates both perspectives. Three principles inform the proposed framework of design.

- Selected models of instruction that best support the teacher's purpose for mastery of content, and the selection of enabling technologies that mirror the selected model of instruction are combined in the design process.
- Models of instruction and enabling technologies are selected according to the nature of the content to be learned, the teaching styles and preferences of instructors, and the learners concerned.
- Promoting and supporting development of the active nature of the learner underscores the entire design process.

The development of this framework took place through a recursive process of experimentation and teaching in two different university courses. The campus course uses concept-mapping software as a teaching aid and as a study aid for students needing to master the more difficult and abstract content areas in the study of German Thought and Culture. The software used was chosen for its ability to mirror the 'meaningful learning' model of instruction developed by (Ausubel, Novak & Hanesian, 1978) and (Novak, 1998). The online course, Introduction to Academic Writing, uses a Web site as the primary teaching tool and its design mirrors the 'expert instructional scaffolding' model of learning developed by (Hildyard, 1996). This model supports the need to ladder content into instructor supported incremental steps that allows modeling of best writing practices through interactive feedback processes.

UsingVisual Organizers and Meaningful Learning to Teach Cultural History

Students unfamiliar with cultural history are frequently presented with a huge number of facts and dates that have little significance to them, encouraging – if not forcing – them to acquire as much as they can through rote learning. The nature of the assignments and examinations often further reinforces rote learning and tends to discourage the synthesis and creative application of the material. The use of visual organizers coupled with instructional design based on a model of meaningful learning permits the student to see how the information communicated in the course is interrelated internally, and also how it is connected with students' prior knowledge. Relationships and interrelationships can be seen and apprehended quickly and easily when represented visually.

Concept mapping conveys information by reducing it to concepts (perceived regularities in objects or events) and propositions (significant combinations of concepts), which are then structured hierarchically and linked by means of lines representing the relationships between concepts and labeled accordingly. Each concept is thus already presented in a contextual relationship with other concepts. This device can be used either as a visual aid in teaching or more actively as an aid to learning. Novak's strategy of concept mapping is based on Ausubel's principles of meaningful learning designed to promote retention and subsequent related learning. These principles include the following:

- The learner must have prior knowledge related to the new information to be learned
- The new material must be relevant to other information and must contain significant concepts
- The learner must choose to learn meaningfully, rather than by rote.

We focus on concept mapping as the most viable strategy to link prior knowledge with relevant new conceptual material, using the CMapTools software package to support this strategy. The software has the features needed for the strategic learning practices outlined above; it is downloadable as freeware and it is easy to learn and use.

Using 'Expert Scaffolding' and the Web to Teach Academic Writing Skills

The purpose of this course is to provide the foundation for scholarly writing that students can build on through further, related coursework and through application of their writing skills in other university courses. Because writing skills are best acquired sequentially, the material in this course is scaffolded into linked, incremental units that build on each other. Throughout the course, the instructor provides expert modeling through feedback as evaluative discourse. Using WebBoard as a vehicle for threaded discussion, students interact with an experienced writer who supports them until skills are mastered at each level. Drawing from (Langer and Appleby, 1986), four design principles for scaffolding were used to inform teaching practice and design of the Web site

- Students were encouraged to assume ownership of their writing tasks
- The assignments were designed to address students' incremental levels of knowledge
- The assignments were designed to support the sequence of skills acquisition in the course
- The instructor and tutors supported students in a facilitative manner

Successful teaching in a course of this nature requires providing ongoing feedback using multi-faceted dialogue with students through commentary on writing and involvement in peer editing sessions. Feedback comes from the instructor and tutors and from other members of the student group. The course begins with a shared basis of readings – reading groups which present their interpretation of texts – and continues with discussion groups which assist writers to refine and elaborate their thoughts, and concludes with peer revision and editing groups. Thus evaluation is embedded in the design of the course and specifically with the design of the assignments. The assignments and final project include interactive exercises, instructor and peer commentary and editing, and online areas for discussing course content.

Conclusion

To date, we have successfully demonstrated in two courses that instructional theory and enabling technologies can be combined in a useful framework to inform instructional design of a given course. The next step is to design research studies that address the impact of using this framework on teaching and student learning.

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To teach remotely by controlling the didactic interaction of a student with a multiapplication environment

Nathalie Masseux
Auvergne University Institute of Teachers Training
20 av. R. Bergougnan
63039 Clermont-Ferrand Cedex 2, France
nmasseux@auvergne.iufm.fr

Conceptual approach

The TeleCabri practices can be articulated with the whole of the experimental studies led these ten last years on remote teaching (Dessus et al. 97) in term of situated learning. The teachers seldom intervening in the realization of the computer-based environments that they use to teach remotely, the purpose of this research is to specify the cognitive influence (Balacheff 91) of the mediation of these environments on the student/teacher interaction. The computer-based didactic systems, with the constructivist meaning of the didactic theory of the situations (Brousseau 86), are its object of study. It is built according to the interactionist approach in HCI (Pochon & Grossen 97) considering these systems as a semiotic mediator by way of the didactic concept of computer-based milieu (Chevallard 92). A computer-based milieu is regarded as knowledge carrier aimed by the learning. We are particulary interested in the milieu which include microworlds or simulators characterized by a significant epistemological validity and a capacity to support a learning guided by the discovery (Masseux & Michau 96). It can thus include a computer-based tool identified like software or/and hardware support of a learning. Here, we center our study on the environments including several educational applications. This study aims at specifying the strategies of didactic regulation engaged by the teacher modelled before in the theory of the didactic situations. These strategies are analyzed using cognitiv models (Anderson et al. 90) of action/feedback between a user and an application who are declined for the student and the teacher. The finality of this research is to develop tools which help the teacher to diagnose in real time the learning activity of the student. It lies within the scope of study of computational didactics applied to mathematics (Balacheff & Kaput 97).

Functional integration of a platform to teach remotely

The functional integration of the platform is based on the capacity of a system to bring answers to the specific constraints of the students and teachers. The functionalities of the platform bring a technological response to the complexity of management of distributed human resources and of which the availability is unforeseeable.

The student/teacher interaction through PCs articulates three types of functionalities:
- functionalities allowing an autonomous work of the student (educational applications)
- functionalities of synchronous collaboration (video, audio, shared applications)
- asynchronous functionalities of interaction (email, sending of files)

Cognitive influence of a multiapplication environment on the remote student/teacher interaction

With TeleCabri, the student and the teacher interact remotely by way of three applications, each one considered here as didactic milieu and each one characterized by an epistemological validity specific to the stake of learning:
- an *oral* milieu, supported by the videocommunication,
- a milieu *Web on the geometry,* including a base of exercises, definitions and properties,

- a milieu *(CabriGéométre)* microworld of direct interaction with geometrical objects provides as a solving board of problem.

To control the student/environment interaction

The regulation which the teacher carries out is conditioned by the sequential organization of the various stages of use of the platform by the student.
This sequential organization can be schematized as follows:
- an autonomous stage of work for the student which precedes the stage by videocommunication with the teacher,
- a stage of videocommunication during which the student requests the assistance of the teacher to solve his difficulties by sharing its applications

The regulation processes of the teachers on the student/environment interaction

The observation underlines the didactic contribution of the property *multiapplication* of the environment. This contribution is observed through the diversity and the accuracy of the regulation processes carried out by the teachers. Those try to exploit the epistemological complementarity of the three *milieu* within the limit of their own functional and cognitive control of the environment.

In short, to control the student/environment interaction, the teachers proceed according to two types of interaction:
- co-operative interactions on the geometrical objects with the interface of CabriGéométre when the teacher focuses himself on the diagnosis while the student concentrates on the autonomous experimental solving of the problem,
- collaborative interactions to create, to modify and to remove objects with the interface of the microworld when the teacher wants to destabilize a balance of action/feedback of the student with the environment.

The process of destabilizing used by the teacher consists in questioning the student on the inaccuracies or the cognitive disjointednesses which arise from the interaction of the student with the three milieu. The regulation in *the oral milieu* in term of formulation, reformulation in the linguistic reference frame of the Euclidean theory, takes into account the collaborative interactions.

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The Total Student Experience

Paul McKey
CTO NextEd Ltd
paul.mckey@nexted.com

Abstract

With the advent of online education the Universities of the world are for the first time exposing their wares in a public space, the Internet, in direct competition and comparison to similar commercial offerings.

While the argument for the University offering as being one of 'accredited academic quality' is easy to win against its unaccredited training and professional development competitors it is not necessarily as easy to suggest the university offering is always a better 'product'.

Universities typically have little experience selling their wares in a commercial environment where price, service and immediacy matter. It then comes as no surprise that when a mature adult learner is shopping around universities are often being overlooked for education alternatives more in tune with the requirements of a modern lifestyle.

The Total Student Experience offers a conceptual framework for the discussion, delivery and measure of an online educational system from the student's perspective. It suggests a model with four distinct layers, which individually and collectively, effect the learner's overall satisfaction with the system. The four layers are presentation, function, education and administration with a number of key variables occurring within each layer?

This paper will discuss the use of this framework and the importance of the underlying assumption that the university 'product' in the online environment will be measured not only by its traditional hallmarks but also by the key elements of the medium in which it is offered. When that medium is the Internet these elements are convenience and relevance, service and value, and the antithesis of the mass production era of education, personalisation.

The complete version of this paper is available at
http://www.nexted.com/news/papers/tse_mckey.html

Telematic Post-basic Nursing Education at the

University of Pretoria in South Africa:

Salomé M Meyer
Lecturer: Nursing Education
Manager: Telematic Education
Department of Nursing Science
University of Pretoria, South Africa
e-mail: smeyer@medic.up.ac.za

Abstract: This paper is on the Telematic Education (TE), which is not the mere use of the television set as a teaching tool/aid. . It should be viewed and managed as a strategic resource. TE refers to a comprehensive system of flexible learning. It emphasises the use of technology that will enhance the teaching and learning environment. Nurses/lecturers have been confronted with the fast development of technology for many years, but mostly in clinical practice. The Department of Nursing Science of the University of South Africa is providing in the learning needs of professional nurses in certain rural areas of the country by means of TE.

1. Introduction:

Broadcast television has been a solution to educational requirements such as the widely distributed campuses of some countries such as Australia and Canada, or even the widely distributed student populations of universities (Laurillard. 1993: 113). To be of any value to a student television education must be interactive in nature. This implies that student and lecturer must be able to communicate during a lecture that is being broadcast by means of television. This brings to mind the concept of Telematic Education (TE), which is not the mere use of the television set as a teaching tool/aid.

2. University of Pretoria (UP) :

No university is immune to the impact of technological change. Organisations can benefit tremendously by exploiting technological change. It should be viewed and managed as a strategic resource. The deployment of the Technology Plan of the UP has already borne fruit. The establishment of the unit for Telematic Teaching and the subsequent virtual campus initiative are direct benefits of the Plan.

3. Telematic Education:

Before one should attempt to understand what (TE) is, it is important to know what is meant by 'flexible learning'. According to Dr. Tom Brown of the Telematic Education Department of the University of Pretoria, TE refers to a comprehensive system of flexible learning. It emphasises the use of technology that will enhance the teaching and learning environment. TE is mostly delivered over a distance. The dependent learner will be more directed by the lecturer whereas the autonomous student who are capable of self-study will be able to employ the higher technological learning facilities. In the educational setting, all the dynamics of the traditional classroom are preserved, regardless of the distance separating the locations". This is the ideal situation to which finances and available sources not always lend it.

4. Interaction:

The structure of a typical teaching session must have two parts. During the first part of the lecture the lecturer delivers the lecture, i.e. passing on knowledge to the students. The second part of the lecture can be in the form of a discussion/question session with high interaction between the lecturer and the students (Jameson, Hanlon, Buckton, & Hobsley,1995:114). The need for students to have back up videos/copies of broadcast stems from the fact that some students might not be able to attend broadcast sessions due to employer demands, technical failure or such like reasons (Jameson et al. 1995:45).

5. The Nursing Education Situation:

Nurses/lecturers have been confronted with the fast development of technology for many years, but mostly in clinical practice. Telematic education (TE) is employed in nursing education (NE) for post-basic programs. Post-basic programs imply that people who have already registered as professional nurses at the South African Nursing Council (SANC) are continuing and furthering their skills and knowledge regarding certain specialities in the profession. Continued education for post-basic nursing requires a distance education method that will serve as an academic solution to professional nurses in rural areas of South Africa. The Department of Nursing Science of the University of South Africa is providing in the learning needs of professional nurses in certain rural areas of the country. Jack Yensen (1996:213), who calls this method of teaching 'telenursing', is of the opinion that the two key dimensions are distance and electronic mediation.

6. The Lecturer:

Lecturers who teach by means of telematic education must be skilled, self-confident, understand the uniqueness of the rural students and should be flexible. They should keep the concepts of adult learning in mind and respect the authority of experience that many students bring to the classroom. Lecturers who have not taught by means of this method need sufficient training. They do not need technical courses, but training on how to adjust their method of teaching as well as teaching aids to that of the telematic medium (Yeaworth. 1996:150). The use technology influences educational innovation.

7. Closing Remarks:

The twenty-first century will see many changes, the first of which will be the end of extensive emphasis on classroom teaching. Teachers, students, and preceptors will come together in dialogues to question, to demonstrate, and to participate actively in the learning process. Nursing will hopefully develop a 'world view'. "Remember, the information revolution will continue to roll on – with or without you. So, get on board and begin changing" (Simpson. 1997:27).

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Technology Acculturation among Adolescents: The School and Home Environments

Leslie Miller & Christine Brandenburg
Center for Technology in Teaching and Learning
Rice University
Houston, Texas, USA
lmm@rice.edu, christyb@rice.edu

Heidi Schweingruber
Rice University School Mathematics Project
Rice University
Houston, Texas, USA
schwein@rice.edu

Abstract: The greater prevalence of computer technology in the daily lives of middle school students is impacting their learning envrionment. Students of both genders and different levels of socio-economic status are well on their way to becoming part of the digital culture. This paper suggests that the gaps that once existed with regard to computer access, use, and perceived expertise are narrowing significantly. These findings are based upon survey data from 512 middle school students in three areas: (a) self-perception of computer skills and their acquisition; (b) exposure to technology at home and at school; and (c) media style and content preferences.

Introduction

Media and digital technology are pervasive in our lives. The advent of technology into the lives and culture of adolescents is not one of choice but of certainty. If we understand the influences at work among our youth, then perhaps we can address their educational needs in ways that maximize what we already know about how to structure effective content. Are there any signs of technology acculturation at work? Have computer presence and increased proficiency translated into any appreciable closing of the previously documented digital divide with regard to gender and socio-economic variables among middle school students?

The Study

Based on a series of small focus groups with middle school students, the authors compiled a 68-item questionnaire, both closed and open answer, to cover students' preferences and practice using different types of media. Students answered the paper and pencil questionnaire during either a science or computer technology class period. Typically, the questionnaire took 30 minutes to complete.

Between October 1998 and April 1999, 568 middle school students were surveyed from eight different metropolitan-area public and private middle schools covering four different school districts. The students ranged in age from 11 to 15 years ($\underline{M}$ = 12.59, $\underline{SD}$ = 0.66). Students who did not report essential demographic information were dropped from the analysis for a final sample of 512 students. Of the final sample, 43.4% were male ($\underline{n}$ = 222) and 56.6% were female ($\underline{n}$ = 290). Schools were recruited to obtain a diverse student population representative of urban and suburban schools, as well as all ranges of socio-economic status (SES). The final sample contained 31% high disadvantage students ($\underline{n}$=158), 33% middle disadvantage students ($\underline{n}$=170), and 36% low disadvantage students ($\underline{n}$=184). Within each SES category, male and females were represented nearly equally.

Findings

The digital divide separating the confidence levels of male and female adolescents with regard to computer use is narrowing. While some significant differences emerged, the patterns of computer use and the purposes of use were remarkably similar for males and females in our sample. As recently as 1994, one study by Sakomoto indicated that among fourth through sixth grade students considered "heavy users" of computers, the ratio of boys to girls was 4 to 1. Our results indicate that this gap is closing as we found no gender difference among those who could be identified as heavy users of computers. Additionally, when looking at the use of computers for identified school subjects, we found similar levels of self-reported computer use between males and females.

In contrast to previous research, both males and females indicate that games dominate the home use. Even in the school environment, games were one of the prime uses. Games remain an important part of adolescents' computer repertoire. These findings, in particular, argue for ways in which to infuse the gaming format with sufficient intellectual content to make the "game" a valuable learning tool. Some educators have already seized upon this notion and are producing more substantive Internet games that incorporate accepted learning theory. The theoretical framework of curriculum built around problem-based or case-based learning could lend itself to a gaming environment. Crucial issues of how intrinsic the problem is to the game scenario and how well do learning objectives translate into an appealing hypermedia format are all ones that would need to be explored.

Conclusions

While the content of educational web sites targeted for middle school students is still an issue for debate, the data from this survey point clearly toward web sites as an effective delivery mechanism. Access, use, and perceived self-confidence in navigating the Internet are less constrained by gender-related concerns than they were less than a decade ago. In addition to the rapid rise in adolescent female participation in technology, the data also echo the research of others in highlighting the prominence of all types of media in the life of adolescents.

The recent Kaiser survey (Kaiser Family Foundation, 1999) found that the average amount of time each day spent using all types of media for children from 8 to 18 years olds was 6.43 hours. The influence of all media in youth's life was reinforced by our survey participants' choices of "your favorite famous person." Of the 512 responses, 74% were performers or musicians. The remaining types of persons named could be categorized as 18% athletes, 3% historical figures, 2% religious figures, and 4% other.

Media of all types are playing a larger role in children's lives; however, it is mostly a solitary experience. Our data indicate that children are largely using the Internet and computers at home free of supervision. It also may not be the case that the computer is replacing other forms of media in adolescents' lives, but rather it is being "added" to the existing repertoire among those who are already "heavy users" of media.

One of the challenges before us is the creation of sufficient quantity and quality of digital materials to attract and retain adolescents' interest in an unsupervised environment. The materials must be free of gender-bias and bridge the gulf that currently exists between how kids learn and communicate on their own and how they are taught in school. Can the production of high-quality, educationally-grounded, and content significant materials attract adolescents to the world of learning via the Web?

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The Development of a Standardized Evaluation Instrument in Educational Technology in a Post Secondary Setting.

Jack E. Morin
George Washington University
Washington, DC
U.S.A
morin@ucalgary.ca

Janice Bakal
The University of Calgary
Calgary, Alberta
bakal@ucalgary.ca

Abstract
This evaluation project examines the required elements for a standardized instrument for the evaluation of educational technology. The project will survey current users of educational technology and seek common threads and patterns in a successful evaluation. This study will attempt to answer this question: What should we be collecting, measuring and examining when evaluating technology in an educational setting? This project is the first step in a multi-stage, two-institution evaluation study that will develop a standardized evaluation instrument for use in the evaluation of education technology. The project will enlist the assistance of two post secondary faculties, clients, developers and students. Each group will be surveyed using an online form. A representative sample from each group will be interviewed in a focus group setting. Expected outcomes of this first stage include the collection of responses from users, developers and clients of educational technology. The survey responses (n=81) have provided a unique opportunity to share and compare educational strategies and concepts between post secondary institution faculty, users and developers. Common patterns were evident within and between groups relative to concepts of educational technology evaluation and important aspects of instructional design.

Introduction
This evaluation project will examine the required elements for a standardized evaluation instrument for educational technology tools and applications. The project will survey current users of educational technology and seek common threads and patterns amongst user groups for the design of a successful evaluation instrument. The goal of this project is to determine what users and developers deem important, valuable and relevant with respect to instructional design and the evaluation of technology in the post secondary arena. The survey data collected will be used to create a standardized evaluation tool. This evaluation tool will assist developers, instructors, teachers, and learners in the design, construction and use of an instructional design model and template suitable for use in the post secondary field of education.

Project Rational and Purpose

First, the research in this area has focused on the application of technology. Evaluation studies on educational technologies have traditionally focused on the particular technology tool and it's impact on the learning environment. While useful in producing data for that tool or application, generalizability to other technologies or application is not possible due to the design of the instrument. Typically these instruments survey specific program issues and fail to consider the larger pedagogical issues of technology (this link provides examples of about 50 instruments of evaluation used in educational technology) [1]. Such programs as the Annerberg's Flashlight Project[2] and McMaster University's EVNet[3] have been leaders in educational technology project, but have failed to develop a standardized instrument, useful in evaluating all types of projects, across multiple users in various circumstances.

Secondly, this project is the first step in a multi stage; two-institution evaluation study dedicated to the development, testing and dissemination of a standardized instrument for educational technology evaluation. The first stage is a necessary step in determining what should be evaluated when examining technology in the education field of study.

Several studies have identified survey instruments and other collection tools for use in educational technology[4 5]. While useful in assessing individual programs for a specific outcome, these types of instrument are difficult to generalize to educational technology, regardless of platforms, users or programs. Determining what should be evaluated in a format that can transferred across technologies and application is a critical next step in valuing educational technology's' contribution to learning.

Conclusions

The first step of this multi-stage evaluation project produced an extensive database of information on what users, developers, clients, and educators think about educational technology and its application to learning. The collection of data ranges from attitudes towards technology to perceptions of technology and its affect on learning. It also provided a resource in the development of a standardized tool for evaluation educational technology.

From this study sample, it is clear that respondents agree on a number of issues in terms of importance and relevance to instructional technology. It is also important to note that there are some differences between respondent groups relative to the evaluation process for educational technology. This information supports previous research in educational technology that has identified key concepts and factors of educational technology.

This first stage of the project provided an opportunity to validate the survey instrument, by seeking some responses to confirm that the evaluation of educational technology is an important aspect of the instructional design process. These findings can be used to development a survey instrument designed to evaluate the important constructs of instructional design with the use of technology.

This first stage of this project provided a unique opportunity to share and compare educational strategies and concepts between two post secondary institutions. It is hoped that the two institutions will share a common ground with respect to the development, application and delivery of educational technology.

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Using Mobile Computer Technology and Internet Tools to Promote Constructivist Teaching

Chrystalla Mouza
Teachers College, Columbia University
United States of America
cpm12@columbia.edu

Introduction

This paper investigates how continuous access to laptop technology and telecommunication tools can promote a student-centered, inquiry-based, problem-solving teaching practice. The purpose of the study is to deepen our understanding on how technology and Internet tools can best be utilized in K-12 classrooms. We present an Internet-based project that utilizes laptop computers in a sixth grade classroom.

Research Questions

We explore how laptop computers and Internet tools are used by a sixth grade teacher who has extensive experience with technology and multiple opportunities for professional development. The overall questions that guide this research are as follows: a) What are the teacher's beliefs about teaching and learning? b) What is the nature of students' assignments? c) What is the role of the teacher and the student in the classroom? d) How are laptops being utilized in the curriculum? e) How is the Internet being used in the classroom?

Methodology

This study began in September1998 and takes place in urban elementary and intermediate schools in New York City. The primary data collection techniques that are utilized include classroom observations, teacher interviews, and document analysis. These activities have been carried out during school visits since the academic year of 1998-99. Participants for this initial research effort include a sixth grade teacher and her students. All students in the class are minority students; the teacher is a white female.

The classroom is part of the Laptop Project, which was initiated by the school district in 1997. All students in the project have been issued a laptop computer. The classroom is also part of the Eiffel Project, a major effort of the Institute for Learning Technologies (ILT) at Teachers College, Columbia University to assist schools and teachers integrate computers and telecommunication tools effectively in their classrooms. ILT provides teachers with technological and pedagogical support, as well as with opportunities for communication and collaboration with other teachers and researchers involved in the Eiffel Project.

Project Design and Preliminary Results

Mary, the sixth grade teacher participating in our experiment, started teaching for first time using laptop technology during the academic year of 1997-98. That first experience provided her with valuable training on the use of computers in teaching. Mary was ready to try new ideas, experiment with different projects, and go beyond traditional instruction. Therefore, she volunteered to participate in the Reach the World (RTW) project.

RTW (www.reachtheworld.org) is a virtual expeditionary venture that uses the world circumnavigation of Makulu II, a sailboat, as an interactive tool for classroom teaching in the United States. RTW utilizes the Internet and other telecommunication tools to bridge the student classroom with different cultures of the world. The crew of the Makulu II communicates with students regularly via satellite email. Since September 1998, Mary accommodated her social studies curriculum to the RTW project. Soon after she started participating in the project, she became the most active teacher. Some of the lesson plans she developed are posted on the RTW web-site as examples for other teachers.

Nature of Student Assignments

Planning an Itinerary. In this project students were asked to form groups and conduct research in order to identify possible sites that the Makulu II should visit on their trip to Singapore. Each group researched different attractions and recommended sites of interest. Students used travel brochures to locate tourist attractions, maps to figure out distances and ways of transportation in Singapore, and historical information from the Internet to identify museums of interest. When the final itinerary was put together it was sent out via email to the Makulu II crew. The Makulu II crew completed the tour and sent back relevant information and pictures to the students via email and air-mail.

Comparing religions of the world. Students studied different religions using information and videotapes that were sent by the Makulu II crew. In sequence, students formed groups and selected one religion to study in-depth. Final reports were presented to other sixth grade students in the school using PowerPoint slides.

The Role of the Teacher and the Students

Teaching was organized around two types of pedagogies: Collaborative knowledge construction and direct verbal instruction. Direct instruction did not represent the dominant mean of communicating knowledge to students. Students were rarely asked to memorize facts. They were instead asked to locate facts using CD-ROMs, books, the Internet, and other resources. The information was then analyzed in order to complete projects and solve problems.

The teacher was mostly a facilitator of learning and a "guide on the site". Students were given opportunities for self-directed inquiry. In many cases they were asked to generate their own questions and search for the answers. Laptops were very helpful because they put a lot of the resources into the hands of the students.

Utilization of Laptop Computers and Telecommunication Tools in the Classroom

Laptops were a vehicle to support the curriculum and expand the classroom's walls. Students typically used application programs such as a word processor for typing and editing documents, databases for organizing information, and graphics packages for developing multimedia presentations. Email was also used extensively in the classroom for communication purposes. Moreover, all students used First Class, an Intranet service that allowed them to communicate with their classmates and teacher after school hours.

Laptops were effective in promoting collaborative work and problem solving. Very often students were required to work in groups and create projects. In collaborative projects, students were required to perform research, collect information, analyze it, synthesize it, and produce a final product.

Conclusions

This paper presented an effort to integrate technology in the classroom. Laptop computers and telecommunication tools were used to provide students with authentic, meaningful, and motivating experiences. Learning became a challenge and students exhibited increased levels of control and creativity. Successful use of technology in the classroom depends, however, to a great extend, on the teacher. Therefore, in any implementation effort, adequate time must be devoted in helping teachers become comfortable with the equipment and absorb the new teaching principles associated with the use of the new technologies.

We currently work with a number of teachers in the New York City area assisting them with their technology implementation efforts. Many teachers use laptop computers and Internet tools for instructional purposes. Therefore, we continue our research by observing what is happening in these classrooms and analyzing changes in the instructional beliefs and practices of the teachers.

Scenario Building to Design a Distance Learning Program

Lisa Neal
EDS
3 Valley Road
Lexington, MA 02421 USA
lisa.neal@eds.com

Abstract: Scenario building is a process that can be effectively used to design a distance-learning program. It begins with the identification of the key stakeholders, who are typically students or participants, course developers, teachers or facilitators, support staff, and administration. Then, for each perspective, the relevant characteristics are identified, followed by a determination of what is required to meet the needs of a person in that category. The process also has the benefit of being a group activity that can facilitate team-building and commitment. We have used this process with multiple organizations and report on these case studies.

Introduction

Distance learning programs are designed in many ways: some evolve from individual efforts, some are designed using available technological capabilities, and others, more recently, are purchased from or co-branded with e-learning providers. Scenario building provides a systematic process for the group of people involved in planning and implementing a program to work as a facilitated team to design a program. The process can be used for any type of organization, including a university or business. It involves a number of steps: determining who will be involved in developing, delivering, supporting, administrating, or taking courses, and prioritizing these to order the next phase. Starting with the most important perspective, usually that of the student or participant, the relevant characteristics of members of that category are determined by the group. This may include computer and Internet literacy, work environment, and time commitments. The group then determines what happens when a representative of that category carries out their role, i.e., taking, teaching, or supporting a class. This results in a list, which is then prioritized, of the needs and requirements from that perspective for the distance learning program. Subsequent perspectives are usually easier to consider after the first, and the entire process leads to requirements analysis and planning for the program. This process has been used for a number of organizations that are planning distance learning projects, including the University of Puerto Rico.

The University of Puerto Rico

The Puerto Rican government funded an ambitious distance-learning program at The University of Puerto Rico. To help get the program underway, the university called on a team of EDS consultants to structure and support the program's essential planning and implementation processes. The team began with strategic planning to determine the tasks and responsibilities needed to ensure the program's on-schedule readiness. During this process, it became clear that the distance-learning concept conjured widely different images for members of the steering committee depending on their knowledge of its theory and practice. Many assumptions were based on the association of distance learning with the room-based videoconferencing that dominated distance education prior to the introduction of Web-based technologies in the mid-1990s. Some of these images did not account for the level of interactivity and engagement that students and teachers experience using state-of-the-art distance-learning technologies or failed to accommodate the important differences between learning and teaching in traditional and technology-mediated settings.

The team proceeded with scenario building, an activity designed to help the program's steering committee understand, envision, and specify technology's role in the new distance-learning offering. Scenario planning began by determining the roles that people will play in the university's distance-learning program; those roles are student, professor, teaching assistant, and a number of support and administrative positions. The scenario-planning work led to each role being assigned characteristics that are relevant to the how a person in that role operates in a distance learning program or that give the role dimension and interest. Characteristics of a student, for instance, included age, family/home situation, educational background, technology literacy, Spanish and English literacy, and typing skills.

The goal was to agree upon the role of technology, the specific types of technology, and the support requirements for technology in the distance-learning program. To achieve this goal, we developed a prototypical member of each role in order to envision, as a group, what a day in that person's life would be like. We carried this to the level of detail of which relevant activities they were engaged in, where they carried out the activities, and what technological and human support was required. There were implications from some of the characteristics of a role; to discuss the activities of a person in a day, we needed, for instance, to know if there was access to a computer and, if so, under what conditions or with what possible distractions it would be used. If there was no access, then a staffed computer room must be available during reasonable hours. Additionally, we considered the implications of atypical but plausible cases for each characteristic, such as the ramifications if a student was older and returning after a period out of school.

Conclusions

The scenario-building process uncovered many issues, concerns, assumptions, and previously unarticulated misconceptions, which led to constructive discussion that culminated in a consensus about technology's role in the project and about the people who would manage and support it. Equipped with the scenarios' insights, we completed a thorough analysis of the program's specific technology needs, identifying and prioritizing the components of the supporting technology. In subsequent discussions, we continued to refer to the prototypical characters, and found that they continued to help clarify issues since the group could look at that person's specific (imagined) needs. Ultimately, the process of identifying each role's relevant characteristics and the hypothetical activities and interactions of a person in that role pointed directly to the criteria against which the entire program will be evaluated, ensuring that the overall effort's success will be measurable and more easily repeatable.

Initiating and Sustaining Collaboration in Technology: Critical Elements

Paula Nichols and Stephenie Yearwood
Department of Educational Leadership, Lamar University
pnichols@tenet.edu; yearwoodso@hal.lamar.edu

Abstract: Collaborative technology projects require new types of relationships and distinctive management strategies. This paper outlines three critical elements in creating and continuing such partnerships: common vision, a reward system, and consensus.

Technology ventures often demand collaborative efforts which bring together personnel, financial resources, needs and solutions from diverse entities. Older models of cooperation worked within top-down power structures; new structures of collaboration are complex and require long-term thinking and conflict management. Furthermore, sustaining collaboration is critical because the payoffs of such efforts are often long-term. We identify here three elements critical to building and sustaining collaboration: common vision, a reward system, and consensus operations.

Common Vision

Diverse groups who collaborate in technology ventures always face semantic difficulties, terms are defined differently and goals are stated in language only the originators understand. As a result, common definitions of terms and in-depth discussion about problems, solutions, and common issues are essential (Winer 1994). In this initial establishment of common understanding, group members must adopt a posture of tentative knowing, a non-judgmental stance which reserves value judgments and allows for continuing conversation. Although individuals may be experts in their domains, they need to drop their "know it all" perspective when they work collaboratively. Rarely does any entity get all it wants, but group members must be honest about what they are willing to put into a collaborative effort as well as what they wish to get out of the collaboration.

A Reward System

Different entities have different currencies and rewards. Rewards must come to group members in the currency valuable to them in their system, be it promotion, tenure, credit hours, test scores, or bonuses. Furthermore, different stakeholders define accountability differently, as staying within budget or positive publicity (Report 1997). As specific rewards are discussed, entities must spell out to whom and how they are accountable and how that will affect their participation.

Consensus

In diverse collaborative groups, absolute agreement is rare. Thus it is essential to establish that the group will operate by consensus and to establish a process for achieving consensus and resolving conflicts. Even when members do not agree on an outcome, if they have subscribed to a specified process which has been followed consistently, they will be able to accept the result (Winer 1994). Once established, conflict resolution needs to be called into play quickly when problems arise. Difficulties which drag on are much harder to deal with.

Clearly collaborative ventures in technology are neither simple nor easy. However, the power of successful collaboration is synergistic. Collaborative groups which are able to sustain their efforts can achieve a whole which is indeed greater than the sum of the parts.

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Integrating Learning agents in a virtual laboratory

Roger Nkambou and Yan Laporte
Département de Mathématiques et informatique
Université de Sherbrooke, Sherbrooke, J1K 2R1
Canada
roger.nkambou@dmi.usherb.ca

Abstract: This paper presents a system called Cyberscience[1] dedicated to distance education. The learning interface of Cyberscience includes a component consisting in activating an interactive multimedia simulation in which the student can carry out direct manipulation tasks making the simulation a virtual laboratory (vitual lab in short). A virtual lab for genetic study is currently realized. As an intelligent distance learning system, Cyberscience includes a number of intelligent learning agents that operates in the space of the virtual lab in order to help students to achieve their goals. This paper presents an overview of those agents.

Introduction

There is already a lot that has been said about software agents, especially intelligent agents' technology. While this is a really a current trend in software engineering. The concept of intelligent agents is at the same time simple in principle and complex in classification (Jennings and Wooldridge, 1998; Nwana, 1999) While intelligent agents systems are widely being developed, most of the frameworks available simplify the architectural and technical aspects and provide relatively no support to implement agent behavior. The goal of this research is to provide people with a strong basic architecture and shell to handle the complex task of implementing intelligent behavior in software agents. The tools provided must have a fairly generic aspect so they can be applied to a wide variety of problems and systems while still being able to adapt sufficiently to a problem to provide relevant intelligent features. It should be possible to achieve such capability by building a set of general-purpose agents that would be easily customizable and reusable.

A set of multiple agents

The first part of building such a set of agents is to determine a set of feature that are desirable and that are sufficiently high level to be reusable. The current proposal includes a planning agent, a decision making agent, a data mining agent, a rule-based reasoning agent, a data extracting agent and a case based reasoning agent. These agents cooperate in the context of CyberScience in order to: create an action plan for the current instructional objective associated with the selected course or theme, according to the student model, select the relevant resource the student will use to achieve the goal, update the student state of knowledge, help the student during the learning process and so on. In the following, we describe each of the agents.

Data Mining Agent. The Data miner has a high probability of being highly useful to many different applications. Basically, this agent's purpose is to retrieve useful information from databases and electronic documents both on a local machine, a network or even the Internet. Of course it can mean only search for certain keywords but it is also possible to implement more complex and advanced intelligent search algorithms. It remains to be decided how it is most convenient to interface with such an agent. It is also to be considered if such an agent should be mobile or not or even if it should decide whether it should move itself to a different host system to be able to accomplish it's job more efficiently.

Rule-Based Reasoning Agent. The rule-based reasoning agent acts mostly as an expert system. Expert systems have proven over time to be efficient to a large number of tasks. The goal of this agent is to derive conclusions from a knowledge base consisting of facts and knowledge. It needs an engine and a set of

[1] This project is funding by the University of Sherbrooke.

deductive rules. It needs an interface to specify the content of the knowledge base. An interface also needs to be defined to query the truth of undefined facts. The engine would be most likely based on the Rete algorithm that is already well known and extensively used and tested.

Case-Based Reasoning Agent. The case-based reasoning agent on the other hand compares the different cases and makes generalizations out of them. When the case-based reasoning agent is invoked on a particular situation it tries to find already known cases that are similar to the current one.

Planning Agent. The planning agent is software capable of making plans. The goal is to come up with a combination of actions to be executed in the future in order to achieve a desired behavior. The interface to the planner agent is a bit more complicated than previously discussed agents, but this is expected considering the complexity of planning problems. First it needs a way to specify an initial state and a goal specifying the desired task to be achieved. It also needs a set of specifications of the actions feasible by the system. Finally it needs a planning strategy, a starting plan and a set of bound parameters both in time and space. The agent's engine would be most likely to base on SIMPLAN because of its capacity to operate in highly variable environments (Nkambou and Kabanza, 1999). This agent will generate a plan of actions repairing the plan given in input that best satisfies the goal from the initial state, given the restrictions implied by the bound parameters.

Decision-Making Agent. Finally the decision-making agent and the knowledge extraction agents are making extensive use of previously discussed agents in this paper. They would probably encapsulate specific instances of these. The decision-making agent, as its name implies, takes decisions about the different tasks to be done and how they must be accomplished effectively. It would work by using the rule-based agent to generate a goal as of what to do. A planning agent starts to search how to best achieve the goal by calculating a new plan while case based reasoning agent tries to find a relevant plan that was previously used in a similar situation.

Knowledge Extraction Agent. The knowledge extraction agent finds relevant information from different digital data sources, Like the decision-making agent, the knowledge extractor uses a combination of three internal agents. It obviously uses a Data Mining agent to retrieve pieces of documents or database information related to a subject requested by an internal rule-based reasoning agent. But a case-based reasoning agent also tries to find similar cases as where relevant was found to help the data mining agent. Once it is retrieve the information can then be used by the system.

Conclusions

The development of the set of intelligent agents involved in CyberScience will lead to a shell to easily implement intelligent learning agents systems. Most of the required features for each agent have already well known solutions. There are also numerous frameworks that already offer facilities to create agents and to give them mobility abilities. It is expected that a higher level of intelligence in behavior of the system would be achieved by close collaboration of these agents. It has to be defined how it should be organized to provide a generic functionality that would be reusable. Also, it must be established how would the specification for a custom system based on these agents would take place. With this shell the use of intelligent learning agents system is likely to widespread. But the first application it is used on, as a test case, is the Cyberscience virtual laboratory. While it could merely be used as a replacement for current expert system to add them a higher level of intelligence, adaptability and interaction level, it is also expected they could be applied to new breeds of problems directed at a less specialized category of users. It can be easily assumed how this system could be used to create assistants or coaches in a context of an Web-based intelligent tutoring system.

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SGML BASED COURSE DEVELOPMENT: BALANCING INSTRUCTIONAL DESIGN AND TECHNOLOGICAL REQUIREMENTS

Solvig Norman, MA
Coordinator of Instructional Development
Open Learning Agency, Canada
snorman@openschool.bc.ca

Abstract

The Open Learning Agency in British Columbia, Canada, is involved in a multi-year project aimed at producing a number of courses that are derived from structured SGML documents. Presently, fourteen courses are being delivered on-line in 33 School Districts throughout British Columbia. This paper describes the use of structured documents for course development with a focus on the benefits and challenges of balancing technological and instructional design issues.

Background

The Open School, a division of the Open Learning Agency, is involved in a multi-year project aimed at producing a number of courses that are derived from structured SGML documents. The goal is to offer innovative and current educational resources for students and teachers that are directly linked to the government's curriculum and provide flexibility through delivery of alternative formats within a distributed learning environment (e.g., for use in a classroom environment and also within an independent self-paced learning environment). Fourteen Grade 11 and 12 courses were developed within a structured document environment using SGML (Standard Generalized Mark-Up Language) technology to meet Open School's goal. These courses are presently being delivered to about 1200 students registered either in one of the nine Distance Education Schools or within one of the regular classroom-based schools in British Columbia.

Open School has traditionally developed large print -based courses with some complimentary wrap around media such as text, video, or audio. Development time from the planning stage to delivery took, on average, two years to complete. Once a course was delivered, it was cumbersome and time consuming to update and maintain. Courses were seen as being out of date, too large, too much work, and provided primarily a singular pathway for students to learn. Open School had some previous experience with developing courses for on-line use, but realized the need to change their course development processes in order to develop more timely and flexible content. The implementation of SGML as an underlying course development tool for planning, development, production and delivery was identified as a means to an end. This technology can facilitate the following:

- creation of courses from instructional design to deliver,
- creation of assessment types and mechanisms,
- identification, association, and categorization of resources within,
- identifies the course architecture,
- creation of custom views of materials for different types of learners,
- storage and management of parts and pieces of course materials,
- output to both print and web, as well as to other media.

SGML has roots in the high tech and publishing industries and is the international standard for representing electronic text in a mark-up language. The mark-up provides a means for interpreting the text. SGML is not dependent on any specific hardware or operating system SGML provides a consistent approach to identifying the components of a document and how they relate to each other. The process permits explicit tagging to identify the components of a "course": lessons, learning outcomes, glossary terms, activities, online resources, etc. There are an infinite number of document structures that can be defined depending on the specific requirements. SGML is a descriptive mark-up language rather than a procedural mark-up language. A descriptive mark-up language uses codes, called elements, to name and categorize parts of a document. Procedural mark-up language, like that of HTML, is often used to represent text in a certain style like bold. SGML also includes a DTD: Document Type Definitions. The DTD defines the "allowed" elements and specifies the order in which the elements may or may not appear. The authoring process must produce documents that conform to the specifications of the DTD.

The Marriage of Instructional Design and SGML: The Benefits

Open School, as part of the Open Learning Agency, has a long history and experience with implementing sound instructional design practices for developing learning materials. Fundamental stages of instructional design including needs assessment, learner analysis, planning (review), development (prototype, formative evaluation), production (evaluation), delivery, and summative evaluation – all have been at the heart of course development practices for over twenty years. Various instructional technologies have been used over the years and have often been perceived as tools whether they were word processing software programs, computer conferencing systems, videos audiotapes, and more recently the World Wide Web/Internet.

However, with the implementation of SGML, instructional design methods became more explicit as part of the structured process dictated by the technology. Open School's SGML based courses have been developed with very explicit Document-Type-Definitions that lay out the architecture of courses from the instructional design planning stage to the delivery stage. This process has permitted course developers to explicitly examine the contents of their courses in a more detail manner that was never before possible. A course basically "grows" from an instructional design plan (e.g., consisting of learning profiles, learning outcomes, resources, proposed activities and assessment) into a fully authored final product (e.g., completed modules with lessons including narrative, instructions, content, activities, and assessment). Because of the structured information approach to course development, "bits and pieces" (e.g., granules, learning objects) of a course can be re-used and re-purposed for other learning situations or outputted to different formats (e.g., print or the Web). Developing 14 courses for on-line and in the print at the same time would not have been possible without the use of SGML as an underlying tool.

The Marriage of Instructional Design and SGML: The Challenges

Although there are many benefits in the implementation of SGML as a course development framework, Open School has also faced a number of challenges. Here is a list of the main challenges:

- Adopting a new technology that entailed a whole new infrastructure (e.g., with new hardware, software, additional staff, extensive training for internal staff, new procedures to follow).
- Reviewing and analyzing existing processes and products in order to come up with consistent structures and language for different course architectures (e.g., deciding on what constitutes a course, a module, a lesson, an activity, etc).
- Designing content to be used in different learning situations. With a database as a backbone, SGML files can be used by other course developers to re-use existing content. There are issues around designing content to be stand-alone (e.g., learning objects). How granular can content be (e.g., a paragraph or a lesson)?
- Ensuring that content which is designed in "bits and pieces" (e.g., learning objects) is pulled together into a cohesive manner which provides an effective learning environment for students.

World Wide Web Course Delivery in Developing Countries: A South African Perspective

Shaun Pather Geoff J.Erwin
School of Mathematics, Information Technology & Computer Science
University of Durban Westville, Private Bag X54001
Durban, South Africa
spather@is.udw.ac.za erwin@is.udw.ac.za

Abstract: There is increasing international usage of the World Wide Web for course delivery. The current South African education system is still structured as a legacy of the apartheid system. The South African government currently promotes the uses of technology to enhance access to education and to foster resource-based learning. The authors report findings of a survey of Web-based course delivery at South African tertiary institutions, including problems being experienced by academics in adopting Web-based techniques.

Introduction

The Internet and the World Wide Web (WWW) are part of a shift away from traditional classroom based course delivery methods (*See* for example Pilgrim & Creek, 1998, p. 189; Kinzie et.al., 1996 p.59). The South African situation does not reflect this trend. South Africa is characterized by a transforming education system that aims to address imbalances brought about by the apartheid era. Disenfranchised sectors of the South African population have historically had limited access to higher education (Christie, 1986).

Background

The South African Department of Education promotes the use of technology (including the World Wide Web) to enhance and widen access to higher education and to foster resource-based learning. The Department of Education is actively engaged in promoting *technology-enhanced learning*. It has initiated a five-year strategic plan, through the National Centre for Educational Technology, to build an infrastructure to support technology-enhanced learning (Department of Education, South Africa). The current social and education systems are still heavily influenced by inheritances from the apartheid political system before 1994. For example, the majority of South Africa's population (mainly black) do not have access to the Internet (*Webcheck* National Survey, 1999). Potential university students have no experience in the use of information and communication technologies (ICTs). Currently, only 0.02% of South African schools have an Internet connection (IDRC, 2000). Their ability to use Web-based education is limited. The lack of telecommunications infrastructure, combined with low levels of technological literacy of the population is a major obstacle to deployment of Web-based material..

The Survey

A survey of academics from fourteen South African tertiary institutions was conducted between June and September 1999. A non-experimental survey method, using a structured questionnaire, was used to investigate the following: *The extent of usage* of specific WWW features for course delivery. In particular the authors assessed to what extent current adopters have used the WWW to move away from traditional teaching methods. Specific features listed in the survey were: Use of Email, posting of syllabi (dynamic & static), detailed course information updated regularly, distribution of lecture notes, links to external sites, feedback mechanisms to students, online chat-room, streaming video, multimedia online lectures, animation, submission of online homework, testing and examinations. *Problems* that exist at tertiary institutions that are impeding the implementation of WWW technology. Specifically the survey examined areas of availability of human and physical resources, organizational conditions, and the attitude of academics to the use of WWW as compared with traditional classroom based methods.

Findings

1. **Current and intended usage of the WWW by South African academics:**

Figure 1 (*see http://is.udw.ac.za/staff/research/web/figure1.htm*) indicates that current levels of adoption of the thirteen WWW based activities listed in the survey fall into two broad categories. The first category reflects a relatively high level of use. The seven activities in this category (e.g. Email, syllabus postings, distribution of lecture notes) are activities that are widely used and are those that support traditional styles of teaching. They do not necessarily change the actual method of classroom-based delivery. A possible reason for this could be that such activities could be implemented at a low cost and with no need to spend a large amount of time doing in-depth planning and design. The second category reflects very low or non-existent levels of use (six activities). This category involves activities (e.g. Chatrooms, multimedia online lectures, online testing) that would significantly move away from traditional teaching methods. These are activities that require intensive planning and design, and are also dependent on a high availability of a technological infrastructure supported by adequately trained staff. There is an increased level of usage. Respondents also indicated an intention to increase level of use of activities that fall into the second category listed above. This is a positive indication, since the activities that fall into this category are those that will realise a paradigm shift away from traditional course delivery methods to a student-centred, constructivist approach.

2. **Comparison of level of South African tertiary institutions with international usage**

The WWW features listed in the survey echoed those from an international survey that was conducted by an American university at the end of 1998 (Peffers & Bloom, 1998). Figure Two (*see http://is.udw.ac.za/staff/research/web/figure2.htm*) provides a comparison between the South African tertiary educators surveyed and those of the international survey. The similarities in the trends are noted in the paper. However, it must be noted that this not imply that the broad state of WWW adoption for course delivery in South Africa is at the same levels of usage as our international counterparts.

3. **Existing difficulties in the implementation of Web-based course delivery.**

Staffing problems: The results of the survey suggest that academic staff do no have the necessary skills to implement Web-based courses. The situation is further compounded by the absence of support staff needed to run Web-based courses. *Organizational conditions*: The Survey suggested that the organizational conditions such as time and flexibility in respect of work commitments do not allow academics (especially if they are novices at implementation of Web technologies) to experiment with WWW technologies. *Financial Restraints*: The problem of shrinking financial resources is affecting service delivery at all levels of education in South Africa. The survey indicates that current budgets do not allow them to invest in Internet technologies.

Conclusion

The desire for on-line teaching at South African tertiary institutions is increasing. The survey indicates that academics acknowledge the positive role of the WWW in course delivery. Key recommendations are: Adopters of Web technology in the classroom need to be encouraged to utilise the Web for more than merely support of traditional lectures; Management at the faculty and institutional level should be encouraged to create the possibility for and invest in adequate training of both academic and support staff. Heads of academic units support the adoption of Web technologies by providing incentives to staff. Tertiary institutions should investigate possible collaboration with external partners in the private sector as a means of alleviating high costs. Some of the issues that require further research and investigation are: international experiences and collaboration with counterparts; Development of guidelines for designing Web-based courses; the long term effectiveness of Web-based teaching on students; the role of academics in developing Web-based courses; and user- friendly authoring tools.

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Online Conferencing: Variations on Structure and Participation

Hsinyi (Sindy) Peng
University of Missouri-Columbia
152 Parkade center
Columbia, MO 65211
Sindy520@mizzou.edu

Gail E. Fitzergald
University of Missouri-Columbia
152 Parkade center
Columbia, MO 65211
Fitzgerald@missouri.edu

Louis P. Semrau
Arkansas State University
P.O. Box 1450
State University, AR 72467

Abstract: This paper looked at the variation of structure and participations for online conferences. Four different structural models were used in designing the conferences, which were (1) Open-ended discussions by expert, (2) Scaffolded discussion with facilitated follow-up, (3) Scaffolded discussion without facilitated follow-up, and (4) Open-ended discussion without facilitated follow-up. Data were collected on frequency of messages, word count of messages, and key word analysis for themes. The findings will provide comparative and descriptive data related to conference structures, participant variables, and levels of participation for future research in online conferencing.

Use of Online Conferencing as a Vehicle for Training Special Educators

There is evidence that materials designed to assist teachers in working with students with behavioral problems are currently in high demand. The design and development of the Internet as a delivery medium for such continuous training in both preservice and inservice teacher education has been documented in special education (Smith, Martin, & Lloyd, 1998). A team of researchers, funded by a U.S. Department of Education grant, has been hosting a series of online conferences for preservice and inservice educators under the auspices of the Virtual Resource Center in Behavioral Disorders (Fitzgerald & Semrau, 1998-2000). These virtual conferences involve the participation of national experts in the behavioral disorders field for the purpose of providing in-depth discussion of topics and social discourse regarding the application of the information.

Design and Structure of the Virtual Conferences

Four different structural models were used in designing the online conferences. Each conference ran for two weeks, but the degree of openness and structure, involvement of the online expert, and the use of discussion facilitators differed across the conferences.

Conference #1: Open-ended Discussion by Expert. 95 participants; 477 messages.
One expert online for two-week duration with all participants in one large discussion group; no required pre-conference preparation or readings; messages not organized by themes or available via archives.

Conference #2: Scaffolded Discussion with Facilitated Follow-up. 105 participants; 283 messages.
One expert online for first week with all participants in large group; participants grouped into four smaller discussion groups directed by project facilitators for second week; required writing of a case scenario; suggested readings offered via web site; messages organized by themes and available on web archives.

Conference #3: Scaffolded Discussion without Facilitated Follow-up. 37 participants; 155 messages.
One expert online for first week with all participants in large group; participants continued discussion for second week without expert or facilitators; pre-conference self-evaluation encouraged; suggested readings offered via web site; messages organized by themes and available on web archives.

Conference #4: Open-ended Discussion without Facilitated Follow-up.
Three national facilitators for first week with all participants in one large discussion group; participants continue for second week without national or project facilitators; no required pre-conference contributions required; free CD-ROM provided prior to conference containing suggested software and resources for viewing; messages organized by themes and available on web archives; greater mix of field teachers participating with preservice teachers.

Preliminary Findings & Importance of the Work

The findings reveal equivalent levels of participation regardless of prior computer experience, teaching experience, access to equipment, typing skills, learning styles, writing anxiety, or frequency of e-mail and Internet use. Writing anxiety may play a role in length of message but not frequency of responding. Graduate students demonstrate significantly higher levels of participation compared to undergraduate students. Less structured conferences allow participants to initiate more of their own topics of concern. Instructors have an important role in providing technical assistance. Instructors and course requirements impact participation and authenticity of involvement of preservice participants. Readings provide common ground for discussion. Written scenarios can be requested from participants, but they emerge naturally. Structure and facilitation provide an even level of participation and ongoing discussion. Messages must be archived by threads for asynchronous access.

This research provides a comparison of online participation <u>during</u> conferences that differ in open-ended vs. scaffolded features and the use of facilitation. Online conferencing appears to be a valid and valued method of providing preservice and inservice training, but the variables of designing and running virtual conferences are more of an art than a science at this stage of research. These studies will provide comparative, descriptive data related to conference structure, participant variables, and levels of participation to guide future research in this mode of instruction.

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CAMPUS: An Innovative Web-based Approach for Simulative, Flexible, Case-oriented Education in Medicine

Jens Riedel, Reiner Singer, Franz Josef Leven
Laboratory for Computer-based Training
University of Heidelberg, Germany
riedel@fh-heilbronn.de

Heiko Geiss
Department Hygiene and Medical Microbiology
University of Heidelberg, Germany
Heiko_geiss@med.uni-heidelberg.de

Burkhard Tönshoff
University Children's Hospital Heidelberg, Germany
Burkhard_Toenshoff@med.uni-heidelberg.de

Introduction

In medical education, Problem-Based Learning (PBL) is becoming appreciated more and more. The design and implementation of a problem-oriented medical curriculum, however, is very time-consuming for the educational staff. Case-based, Web-based training systems can help the educators to develop, implement, organise and reuse well-structured multimedia cases. For students, such a system can be used to improve and test their problem-solving competence. With respect to heterogeneous learning environments, the system should be flexible and adaptable. CAMPUS tries to meet these requirements by covering the needs of different user groups (e.g., students, educators, physicians) in different application scenarios (e.g. self-study, presentation, learning groups) to get maximum benefit of integrated medical cases. With the CAMPUS player component (learner's front-end), users can work out medical cases in a simulative - and therefore realistic and interactive - way or let the system present a case in different manners. Users can get help via expert comments or context-sensitive systematic knowledge which is available in addition to the case data. With the CAMPUS authoring component, medical experts can feed the system with cases from any medical field. CAMPUS, part of a comprehensive virtual university project, is going to be integrated in a reformed medical curriculum approach at the University of Heidelberg.

Methods

The idea of CAMPUS is to develop a case-based, Web-based training system in Medicine including a broad variety of usage modes with the aim of minimizing acceptance problems and maximizing the effectiveness and efficiency of case-data input, which is time-consuming and still one of the central problems of case-based systems.
To achieve such a functionality, CAMPUS provides the following features:

a) Integration of medical cases from any medical field
b) Storage of case data in a very detailed manner in a relational database
c) Presentation/treatment of cases in different adaptable ways
   The degree of interactivity/realism of a case presentation/treatment is optional. The most interactive form is 'decision', where the student has to treat a case in a realistic, simulative way leading to a maximum of active knowledge processing. The user has to ask questions of anamnesis, order physical, lab or technical exams, make diagnostic decisions and propose a therapy. In the form 'compact' the student only has to make diagnostic decisions and propose the therapy. The results of the different tests are shown en bloc. If a user is only interested in medical case data he can choose the form 'total', where the whole case is presented at once with no interactivity at all.
   With these different forms of application the user can look at a case the way he likes and is able to. For example, if a user does not want to do the anamnesis on his own for any reason, he may choose the form

'compact'. If, on the other hand, he wants to concentrate his learning activities on the physical exam, he may choose the form 'decision'.

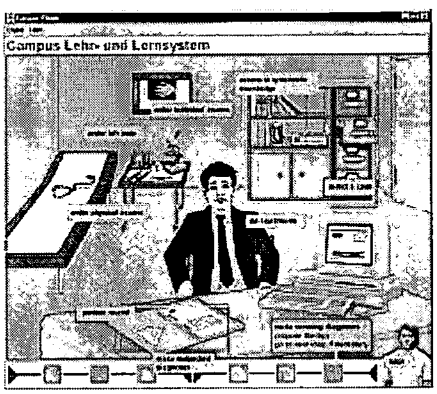
d) Expert comments on demand
It is very important to explain certain things about a case, e.g., why a diagnosis has been made or why a particular exam has been done. Hence, for every particular point within a case the CAMPUS author can define an expert comment.

e) Questions if wanted
Questions are - besides other things - an important aspect of interactivity and active knowledge processing. Thus the case author can define questions of different types on every definable point within a case, e.g., after or before the user gets the answer to a certain question of the anamnesis or after or before the whole physical exam. The user can choose if he wants to see only case-dependent questions, case-dependent and case-independent questions or no questions at all.

f) Distinction between case data and systematic knowledge
Every user has a different state of knowledge. Therefore, every user needs help at different points when working on a case. Hence, CAMPUS shows context-sensitive systematic knowledge only on demand. The knowledge can be internal (integrated by CAMPUS authors) or external (using external knowledge sources from digital libraries over the internet).

g) Detailed case search
Cases are searchable by defining symptoms or diagnoses. For example, one could look for cases with fever, shivering and chest X-ray abnormal. Such a specific search is possible because of the detailed database.

h) Execution over the internet/intranet or locally
To acquire platform-independence, permanent actuality and world-wide access along with all capabilities of a programming language, CAMPUS is implemented in Java as a Browser applet. For users at home, it may be better to have a local application to save time and costs. Therefore, CAMPUS is also executable locally using a local database.



In order to avoid the structure and vocabulary of cases varying from author to author, a case has a well-defined structure and has to use a defined vocabulary for anamnesis questions, exams, diagnosis (ICD-10) and therapies. Every case has the following structure: anamnesis, physical exam, suspected diagnosis followed by one to many passes of a therapy loop with examinations (physical, technical, lab), working diagnosis and therapy. That means that, unlike many other case-based training systems, CAMPUS doesn't stop at the first diagnosis given by the user but considers a case in a more detailed and realistic way.
To give the user an easy to understand user interface, we implemented a so-called situated learning environment, where the 'situation' is a physician's room.

Conclusion

CAMPUS implements a new dimension of flexibility of a case-based, medical Web-based training system. It can be used by different user groups in different learning environments. Therefore, the effectiveness and efficiency of the time-consuming case data input has been improved. CAMPUS offers the chance to develop a case-database with well-structured multimedia cases to be used by students as well as educational staff (especially in problem-oriented curricula) who can use and - more important for the educators - reuse cases in several scenarios.
A first prototype is available and is going to be integrated in the reformed medical curriculum at Heidelberg at least. A comprehensive evaluation is taking place in June/July 2000. An international version of CAMPUS is planned.

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Evaluating the Effects of Web-based Collaboration in a Distance Education Program

Paul Rodes, Haejin Chung, Dennis Knapczyk, Carrie Chapman
School of Education, Indiana University, Bloomington, USA.

Abstract: To study the effects of asynchronous web-based collaboration in an existing video-based distance education program, the authors structured coursework to enable evaluation of differences in cognitive and emotional aspects of learning between those using web-based collaboration and those completing assignments through traditional independent methods.

Educators have increasingly recognized the important role collaboration can play in learning. Asynchronous web conferencing has been identified as a unique tool in promoting such collaboration, particularly when applied in distance education coursework [Knapczyk, Chung & Baik 2000, Moller 1998, Duffy et al. 1998, Bonk & Cunningham 1998, Ernest 1995, McMahon, O'Neill & Cunningham 1992]. In the past three years we have integrated web conferencing into our existing video-based distance education program at Indiana University to promote collaboration and ownership among learners [Rodes et al. 2000, Rodes, Knapczyk & Chapman 1999, Chung, Rodes & Knapczyk 1998].

While we have been pleased with the results of web conferencing in our program, we recognize the need to evaluate its effects in verifiable terms. In fact, although much has been written about the benefits of asynchronous web conferencing, few studies have been conducted to verify these findings. The education literature typically offers descriptions of programs and effects, with little controlled study or verification. Furthermore, little has been written on the possibilities of web conferencing when integrated with other distance education technologies. To address this lack, we have been conducting a study in Spring 2000 to investigate the effects of asynchronous web-based conferencing on both cognitive and emotional aspects of learning.

The Collaborative Teacher Education Project at Indiana University offers graduate-level special education coursework to cohort groups of teachers in rural Indiana communities. Classes are delivered via two-way video and are supplemented by e-mail, fax machines, and web-based conferencing using the SiteScape Forums web conferencing system [Knapczyk et al. 2000, Knapczyk, Rodes & Chung 1998]. In the Spring 2000 semester we offered a single course on behavior management to in-service teachers at six sites.

For the current study we divided our course content into four units. The independent variable of our study was the use of asynchronous web-based conferencing. For each unit, we developed two parallel sets of assignments and activities: one set was to be completed individually with collaboration taking place at the learners' discretion; the other set was to be completed collaboratively in web-based learner teams. During each unit, learners at three sites completed their work using web-based collaboration, while learners at the other three sites completed their work using the "traditional" assignments.

To facilitate direct comparison, during every unit each web-based site was paired with a non-web-based site to meet for a video-based course once a week. In this way we ensured that the sites to be compared received the same instruction. After each unit the roles assigned to the groups were reversed. For example, learners in Tell City were linked each week with learners in Spencer in a video session originating from the IU-Bloomington campus where the instructors were located. For the first unit of the course, the Tell City group completed assignments in web-based teams, while the Spencer group completed assignments individually or using informal collaboration. For the second unit of the course, these roles were switched, and so on. By pairing sites in this way, by switching the assigned roles at the end of each unit, and by repeating this full cycle two times during the semester we aimed to minimize the effects of any differences among learner characteristics and environments across the different sites.

The dependent variables we have been investigating reflect both cognitive and emotional aspects of learning. We are evaluating the following three elements of content learning [Bloom 1956]:

- acquisition--through product evaluation and content-based tests
- application--through product evaluation and field reports from learners
- retention--through follow-up tests and surveys on content issues

In the emotional domain, we are using both immediate and follow-up surveys to evaluate learner satisfaction, which is a particularly important factor to consider in working with adult learners [Galbraith 1998].

A specific grading rubric was used to ensure uniformity of evaluation and to be sure products were assessed for issues of applicability as well as acquisition. To facilitate clear comparison, all surveys, testing, and product evaluation have been linked to the four individual units of the course. In this way we can compare the results at each study site not only to the linked cohort site using the opposite approach, but also to the results at that same site during other units, to track any differences as learners moved from web-based to non-web-based activities.

By completing this study we hope to have gathered reliable data on the effects and the effectiveness of web-based collaboration when combined with other distance education technologies. We anticipate that our findings will contribute to an understanding of the importance of collaborative learning and web-based conferencing in distance education programs, and for education in general.

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The Design, Development and Implementation of Education in Edubox

Ellen Rusman,
Open university of the Netherlands
Valkenburgerweg 167
Heerlen, The Netherlands
ellen.rusman@ou.nl

Peter B. Sloep
Open university of the Netherlands
Valkenburgerweg 167
Heerlen, The Netherlands
peter.sloep@ou.nl

Abstract: *Edubox*® is a system, built at the Open University of The Netherlands, that supports educational innovation processes in higher education. The system allows maximal *flexibility* in that it enables educational designers to model an instructional system completely after their ideas. In this paper the phases of the design, development and implementation of an instructional system are described with particular attention to *Edubox*®.

Introduction

Edubox® is a system, built at the Open University of The Netherlands, that supports educational innovation processes in higher education. The system allows maximal *flexibility* in that it enables educational designers to model an instructional system completely after their ideas, unhindered by implicit didactic beliefs similar systems often harbor.

An *instructional system* is here defined as the assembly of 'objects' that collectively assist a student in acquiring a set of learning objectives. At a more concrete level, an educational system features such items as *people* (e.g. teacher, fellow students, experts), *tools* (e.g. word processor, browser), *knowledge sources* (e.g. books, videos, cd-rom's), and *activities* (e.g. writing a paper, peer-assessing a fellow student).

Design Stage

Edubox® is able to provide the eductional designer with such freedom and flexibility because it makes use of a didactic metamodel embedded in an Educational Markup Language (EML) - a generic XML-based language - as described by Koper (1999).

In principle, everything the learner or teacher will experience in *Edubox*® has to be modelled by the designer. In contrast with traditional electronic learning platforms it does not make any (implicit) assumptions (Onstenk & Meijer,1998; Dabbagh, Bannan-Ritland & Silc, 1999) on preferred didactic scenarios, thus providing the designer with a didactic "clean slate".

When working with *Edubox*® the educational designer, needs to focus his design activities on two main questions right from the start:

- What is the structure of the instructional system needed to support the acquisition of certain learning objectives by students?
- What will be the delivery medium of the designed instructional system?

Decisions on the Instructional System

The instructional system to be developed may be modelled at several levels: the micro-level (e.g.module), meso-level (e.g. course), and macro-level (e.g. curriculum). The designer has to make up his mind about the main level for his design activities. Subsequently, the designer has to opt for a pedagogic approach, taking into account several ingredients of his instructional system:

- educational objectives and prerequisites, (aimed at the acquisition of knowledge, skills, attitudes, competences, complex cognitive skils) and target group
- relations between the stated educational objectives, prerequisites and the structure of the instructional system
- the context in which the education takes place (roles, sources, instruments, on-the-job)
- situational experiences and domain specific information in education
- individual differences
- co-operation and collaboration
- communication
- the use of different educational matcrials
- assessment
- the kind of activities which have to be performed to assure learning processes
- the learning process and transfer processes passes off
- stimulating motivation
- sequencing actvities

Descisions on the Delivery Medium

The educational designer has to make a decision on how the educational system will be delivered to the learners. For example: will the product be a book or will it be delivered on the Internet? Depending on this decision and the level of implementation of the instructional system, the designer will have to design a style sheet for the lay-out of a book or an entire graphical user interface (G.U.I.).

Development

Developing the Instructional System

In the development phase the whole instructional system has to be structured using the Educational Markup Language (EML). For specific pedagogical orientations (e.g. problem-based learning, case-based learning), ready made EML-templates may be available. EML knows the following main elements (Tab.1):

element	description
metadata	all general data concerning an educational object
roles	the different roles persons can have within an instructional activity
objectives	(learning) objectives which are related to an instructional system
prerequisites	prerequisites (e.g. in terms of knowledge, personal charactaristics, instruments available to learner) related to an instructional system
content	all componounds (defined within the elements 'activity' and 'environment') which are conditional for the acquisition of (learning) objectives
activity	a stimulation of the learner to perform certain behavior
environment	componounds (e.g. tests, knowledge sources, instruments) which are conditional for the acquisition of (learning) objectives
method	structure, didactics and processes within an instructional system

Developing the delivery medium

In the development phase the necessary features for publication to the medium chosen during the design phase should be developed.

Implementation

Because of the richness of EML and the flexibility of *Edubox®*, different designers may implement similar ideas in very different ways.

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Technological Tests of Educational Theories: A Research Role for the Generative Virtual Classroom

Dr. Lynette Schaverien
Faculty of Education, University of Technology, Sydney
PO Box 222,
Lindfield NSW 2070 Australia
Lynette.Schaverien@uts.edu.au

Abstract: Throughout history, technological advances have led to scientific breakthroughs. Computer-mediated learning environments have the potential to function similarly: as technological tests of educational theories. Here, this unexplored research role, for one such learning environment, is illuminated. The Generative Virtual Classroom, a web-delivered virtual classroom for teacher education, is demonstrated and preliminary research findings with respect to theory advancement reported. Some emerging implications for computer-mediated learning and for the generation of educational knowledge are discussed.

Cultural development is littered with striking examples of technological advances that have led to scientific breakthroughs. The successful building of European cathedrals provoked the development of a detailed engineering science (Bronowski 1973/1992). In our own time, pioneering brain-imaging technologies have brought important new neuroscientific insights (see, for example, Carter 1998 and McCrone 1999). Similarly, technological tools for learning, especially those designed on particular educational principles, ought to expose the worth of those principles. In action, such technologies may well constitute a potent and, as yet, unexplored research tool by means of which educational theorising can be advanced. In this work-in-progress paper, I explore this research role for one such technological tool for learning: the Generative Virtual Classroom.

The Generative Virtual Classroom

This paper begins by demonstrating the Generative Virtual Classroom itself, so as to elucidate its educational principles. Emerging from a series of classroom studies of learning and learning to teach (in particular, Cosgrove & Schaverien 1996 and Schaverien & Cosgrove 1997), this web-delivered learning environment attempts sophisticated computer-mediated teacher education in elementary technology-and-science. Its design embodies a generative view of learning in which learning is conceived as a generating and testing cycle (after Minsky 1986, Wittrock 1974, 1994 and Plotkin 1994,1997). According to this view, learners generate ideas that they then test on their value, keeping those that survive their tests (Schaverien & Cosgrove 1999, 2000). In a nested pair of virtual classrooms (a virtual elementary one and a virtual tertiary one), Education students can develop their views of learning by observing exemplary learning by young children from an archive of pre-recorded digitised video excerpts. They can formulate their thoughts about these excerpts and communicate with others about them, considering others' views of them, including, in particular, a generative view of learning. As an environment in which learners can develop a generative view of learning, in ways consistent with such a theory, the Generative Virtual Classroom is poised to be a powerful technological test of this generative theory itself.

Do Learners Learn Generatively in the Generative Virtual Classroom?

Already, pilot research conducted in the Generative Virtual Classroom affirms the fruitfulness of viewing learning generatively. For example, in a nine-month autobiographical study of the development of her views of learning in the Generative Virtual Classroom (Allard 1998), an Honours Education student was able to establish her conceptual progression, for herself, and to identify what she still needed to understand. On analysis, this student's learning was well explained in generative terms; and, as well, on the basis of her experience, minor alterations were able to be made to the learning environment itself. Such studies suggest the value of proceeding to larger scale tests of the worth of this theory. Consequently, a large-scale collaborative research trial of the Classroom is now in its beginning stages. In this trial, a full cohort of First Year Education students (n=~100) has begun to work in the Generative Virtual Classroom, yielding early data on the nature of the learning of a diverse range of individual students over a semester. Students' text contributions to the Classroom's community database and e-mail discussion group will be collated, described and analysed for evidence of generativity, in an attempt to assess the worth of such a theory in making sense of what they did.

Implications for Computer-mediated Learning and the Generation of Educational Knowledge

Clearly, the recent proliferation of technologically mediated environments in which learners can teach themselves has brought new opportunities to explore the nature of learning. Even more recently, such writers, inter alia, as Alexander & McKenzie 1998 and Hannafin, Hannafin & Oliver 1997 have begun to insist that these new learning environments be explicitly grounded in educational principles. From these positions, it is a short but significant step to conceiving of computer-mediated learning environments as instruments for the testing of educational theories, an idea whose time has come. Once crystallised in these terms, such a research program has the potential to redress long-standing dissatisfaction with the apparent lack of theoretical progression in Education in particular (Thagard 1992) and in the social sciences in general (Ziman 1978/1991). The paper closes speculatively by discussing the implications of such a re-conceptualisation for computer-mediated learning and for the generation of educational knowledge.

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From Student Needs to Instructor Roles: An Ethnographic Viewpoint

Richard Schmertzing
Valdosta State University
Department of Educational Leadership
Valdosta, Georgia, USA, 31698
rwschmer@valdosta.edu

Lorraine Schmertzing
University of West Florida
9520 Scenic Highway
Pensacola, Florida, USA, 32514
ldavis@uwf.edu

Abstract: This paper draws on data gathered during a year-long ethnographic study of graduate education classes in a 2-way audio 2-way video distance education classroom. Cultural analysis of transcript excerpts indicating student reactions to their experiences in the technologically mediated classroom highlight the anxiety and confusion they experience in making the shift from the familiarity of traditional classroom culture to the uncertainty of a new, often strange environment. This transition phase in classroom cultures, what Turner (1969) calls the liminal phase, is a time of high anxiety but also of high learning. Our data suggests that instructors who take on the role of technology guide and provide students the opportunity to vent anxiety and learn about the technology, create environments that significantly increase the comfort levels of students and receive much higher ratings from them.

Introduction

Distance learning, via web based and two-way interactive video classes has changed the market areas of educational institutions from how far faculty are willing to drive to how far the Internet or phone lines will reach. Given this new global market, institutions of higher education are rushing to fill the niche. Students are recruited, new learning environments are created and faculty are suddenly asked to teach classes in front of computer screens and cameras. Although the literature encourages the use of instructional design principles when teaching this way (Moore & Kearsley 1996), in the rush to stake out new territory, such classes are often thrown together with little planning and less understanding.

According to Willis (1993), "research suggests that distance education and traditionally delivered instruction can be equally effective if the distance educator puts adequate preparation into understanding the needs of the student and adapting the instruction accordingly" (p. 22). But how does one do that? How can students and teachers anticipate their needs in a substantially new learning environment? Are these new learning environments traditional classrooms with a few technological add-ons where the assumption can be made that student's needs are little changed? Or are they complex new environments that require descriptive and analytic illumination by researchers such that student needs can be assessed and then addressed? Our research suggests the latter.

It is our contention, that the situation people face in distant classes is, from a cultural perspective, radically different from the traditional classroom. The enculturation process that occurs during years of schooling solidifies in the learner norms for the role of the teacher, for methods of classroom communication, and for student interaction that lasts a lifetime (Henry, 1955). The entire dynamic of teaching and learning, which is deeply grounded in traditional classroom culture, is changed in complex and nuanced ways when the class becomes technologically mediated. The study on which this paper is based used the approach of ethnography and the perspectives of cultural anthropology (Geertz 1973) and social interactionism (Mead 1934) to uncover these changes in classroom culture and illuminate changes in the teaching/learning dynamic.

In this brief paper we can do little more than present fragments of interviews to show how descriptions by students of their distance education experiences and an awareness of traditionally based student expectations can inform a deeper understanding of the needs of students. This understanding then becomes the basis for strategies that instructors can use to help learners through the cultural transformation process and to have more successful learning experiences.

The Study

The study is based on data gathered for an ethnographic case study of graduate education classes during the inaugural year of a 2-way audio 2-way video interactive distance learning classroom. Courses included in the study varied significantly in teaching style, course objectives, course content and student responses. Traditional ethnographic and qualitative research methods facilitated data gathering and analysis (Agar 1996; Maxwell 1996). Data gathering involved more than 400 hours of participant observations in classrooms, formal interviews and informal conversations with students and faculty, weekly e-mail correspondence, open ended surveys, focus group interviews, and video of all classes. Thematic coding, frequency counts, and frequent debriefings between ethnographers L. and R. Schmertzing contributed to interpretation and ongoing analysis of the data (Spradley & Mann 1975).

The Data

Excerpts of student comments from e-mails and interview transcripts introduce the complex culturally based issues that students face in the interactive televised classroom. All of the following passages were written by students in response to questions from the researchers regarding the students first night in the distance classroom. We will present the excerpts in the data section and comment on them in our discussion.

> When I saw the room set up I was in shock, actually. It was my first interactive distance learning class and I walked into the room thinking "why did I sign up for this?" At the sight of all these different video screens and cameras all around the room, I didn't think that the grades would be the same. I thought they would favor the class that had the most physical interaction with the professor. I became sort of jealous of the other campus and resented the fact that she (the instructor) was there. I felt like I was at the main campus where the professor should have been. If the other class was at a branch campus, they should have primarily been in the distance learning aspect of it. My GPA is very important to me. I feel that the grade I earn will be affected by how much time I will have to spend watching her on a monitor. There were so many distractions, it was hard for me to stay focused. Also, there was so much zooming in and out with the video cameras, I honestly got motion sickness and walked out of class feeling sick to my stomach with a headache. I did not like it. The cameras were set up in awkward angles and you couldn't see the professor's head when she was talking. We got great views of the back of her head.

Many students made similar comments, although the attitudes of others were more like the following who noticed the difference but struggled to adjust.

> I was really surprised at my reaction. I've taken a web-based class before and I have seen the equipment for this classroom before. I didn't think I would feel any different, but I did! I was surprised at how I looked on camera and feel that I will have to work on this so that it doesn't impact my participation. Also, I forgot several times, where to "look" so I would be facing the remote group when I "spoke". I also found that as the night wore on, I kind of avoided responding to questions 'cause I felt like I was monopolizing the session. I did like being able to "face" the other group and do not feel that the experience effected my learning. I found myself "concerned" about the remote site when we had a few technical problems and am concerned about the learning experience when the instructor goes to the other class and I am in the remote site, having to rely on the technology.

For some students the two-way audio/video class they participated in was an entirely positive experience. "After the first night of class I am totally satisfied with everything. I especially enjoy being able to take the class at this campus and am excited to have the opportunity to be a part of this class."

Other students cited particular elements of the technologically mediated classroom that fed their anxieties and complicated their ability to focus in the classroom. "I'm just much more aware of asking questions and making contributions, because I have to do this mechanical thing." The necessity to physically encounter technology in order to participate in class confused students and contributed to a magnified concern for the value of their own comments. "You don't have the ability to just sit there and say, 'Wait a minute;' you're on camera now, you're on air-time, and so if you have what you think may be a *little* question, you're wasting class time [if you ask it]."

Discussion

The variation in student responses points toward the diversity and complexity in their perspectives. Students from each class all have different ideas about their experiences in their new classroom environment. They all, however, enter the classroom with an understanding of the way a traditional class works and quickly confront the differences. Students expect the classroom to look a certain way; they expect to focus on a teacher standing at the front of their classroom; they expect to have easy means to speak and be heard. When these culturally based expectations are not met, students are often left with a sense of anxiety and feelings of uncertainty. We found that complex technologically mediated interactions between learners, instructors, and content forced the re-construction of the way participants had previously "done class." Learners, caught between the old way and the new way, moved through a liminal state (Turner 1969) to find a balance that provided enough comfort with the environment so that distractions were minimized and learning maximized. The student need indicated in this paper is the need to be guided through this liminal state, the need to be helped through the adjustment phase. In such a context, the new role for the instructor is as a guide.

Instructors that we observed to be successful guides used various strategies to speed up and enhance students' adaptation to the new classroom. Students found balance more quickly when instructors recognized, articulated, and showed sympathy for the "awkward," "uncomfortable," "surprising," "overwhelming" state of the learner. When instructors talked to their students in an "up front," "understanding," "sensitive," (from student transcripts) manner about the strangeness of having class in the new environment, students were more responsive to instructions on how to use the technology to accomplish class goals. When learners were allowed opportunities to express their feelings about the environment without fear of repercussions, they appeared to overcome the added burden of "hiding [their] anxieties" about to taking a distance class and became more "willing" to work with the new technologically-mediated environment. The instructor who provided students the opportunity to "vent" through both class discussions and online threaded discussions achieved the highest rating for classroom interaction of all the instructors considered in this study and did so in the least amount of time.

The style, manner, and attitude an instructor established the first night of class was also a key factor in how long it took students to learn the technological system and for the ease and speed with which they learned to function effectively. First class meetings rated highly by students were those that were characterized as "fun," "calm," and "slow enough to understand." Instructors who, in early classes, laid ground rules for communication, clearly and completely explained the technology of the classroom, gave students an opportunity to use the system in a non-threatening manner, and provided a thorough picture of what would be expected throughout the semester built bridges between participants and the technology. Once the bridge was built and the connection made, the environment felt "safer" and interaction took place more easily.

These are a few of the insights and strategies that have emerged from our analysis so far. We expect that our continued analysis will produce many more.

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Introduction of a New Media Concept for a Teaching Profession Degree in „Computer Science“: A Formative Evaluation

Axel Hunger, Stefan Werner, André Bresges and Frank Schwarz
Gerhard Mercator University Duisburg, Department of Dataprocessing
Bismarckstr. 81, 47057 Duisburg, Germany
e-mail: {hunger | swerner | bresges | schwarz}@uni-duisburg.de

Abstract
Within the scope of the development of a new multimedia education concept for the teaching profession "Computer Science", the strengths and weaknesses need to be constituted already during the development-phase and weaknesses need to be eliminated if necessary. Therefore, the concept is examined within the formative evaluation on its tangibility and effectiveness.
The newly developed education concept, which was developed at the Gerhard Mercator University Duisburg under usage of new media, aims at creating new possibilities for differentiation and decentralized learning by a multimedia teaching and learning concept. The didactical new conception of the course is supposed to take the students different learning prerequisites into account. Thus, procurement methods are striven for that enable individual preparation, consultation and practice dependent on the students educational background.

Introduction

The teaching profession with the vocational field "Computer Science" at the Gerhard Mercator University Duisburg can be attended by students with different main subjects. Students can combine the specialized professional field "Computer Science" with different main subjects, e.g. mechanical engineering, chemistry technique or textile and clothing technique. So a teaching concept had to be developed due to the different bases in the information technical education of the different courses. It has to consider the heterogeneous foreknowledge of the students and offer according intensive procurement methods.
The developed concept is used in the basic course "Fundamentals of Computer Science" as first trial phase. The course covers topics such as the Boolean algebra or switching algebra, the technical implementation of logical operations, which are based on the Boolean algebra and finally the fundamental digital circuits and systems as well as simple digital computers, which are based on these operations.
The procurement of contents and the conversion of the quoted objective requires the completion of the course forms so far by means of a suitable concept on computer base and the transfer by means of multimedia technique. The interactive, multimedia teaching and learning software is set up in such a way that the different learning methods of the students are taken into account. Therefore, different points of entry are available for the software.
One entry point runs over the content structure, here the student can choose his learning path in accordance with the content of the lecture. The course so far included exercises for practicing and applying the taught methods. This exercise part is also integrated in a suitable form into the interactive learning concept. The second entry point clarifies the interaction between the acquired knowledge and the latter practice on the basis of a descriptive task. Thus, a learning goal oriented or res. a problem based learning is enabled. The student receives an course of action. A detailed description of the concept is given in (Schwarz, Hunger, Werner, 1999).

Initial Considerations for Evaluation

Sources of information that are available for a study group are on the one hand conservative sources such as books, scripts and patterns, the instructor and laboratory/experiment device. Additionally, fellow students also count as information source, since notes, sources of information and interpretations can be exchanged with them.

New media can take the place of an information source (book) and the place of an experiment device (simulations). It can also partly take over the role of a teacher, by answering standard questions and checking exercise results, as far as the exercises are machine controllable. Furthermore, new media creates more extensive communication possibilities (Dweck, 1988).

The entire focus during the introduction of new media in complex, problem based learning situations is determined and already distributed on different learning tasks. The attention can not be increased by the introduction of new media! In the case of new channels being available, the individual must redistribute its bandwidth and thus its attention on the available channels. A rearrangement takes place on expense of other channels. Refocusing might lead to a favoring of channels due to improved accessibility of information through new media, which enables individuals to receive information more easily and thus the attention on other channels is encouraged. We can speak of a positive modification of the social behavior induced by introducing new media, if both possibilities deal with the channels which the individual use to interact with other members of the group.

Formative Evaluation

The concept is evaluated in several steps. In the first step, the teaching and learning processes are evaluated by observing and interviewing the participants. The experiences of students from different subgroups are of importance and thus raised in particular. The members of the group are interviewed by using a questionnaire. This questionnaire ranks important data through accordingly formulated questions on socio-metric matters for the 4 partitions of the theory model (economy of attention, social behavior, motivation control, accessibility of information). The behavior and movements of the user is recorded at the same time. Thus, it is to be determined, whether the mapped mental model is applicable on the learning group and whether weaknesses in the navigation and comprehensibility can be discovered. The results flow directly into the development. Furthermore, an expert workshop is set up in order to determine suitable scenarios of different emphasis. The expert workshop primarily consists of professors of the respective field.

The evaluation leads to the following results:

70 participants were interviewed, among them where 25% that use MODULO regularly. The participants hardly use MODULO for stringent reading, but rather for the direct search of information. This functions well to outstanding; students indicated that finding information under usage of MODULO is substantially better. The links between exercise and lecture were considered as helpful. The complex scenarios, which are supposed to clarify the application of knowledge in vocational practice, are considered less helpful for understanding the material. Most students rather find the scenarios helpful at ranking the material into vocational practice.

In a further step, a summative evaluation will take place after final completion in order to elevate the acquired knowledge of numerous years and using it for advancements of the concept.

Summary and Prospect

In this article a new concept for supporting the theory of the teaching profession course "Computer Science" and an appending formative evaluation was presented. The concept aims at media-technical editing of the disposition, the development of a training concept and the development and implementation of a WEB-database with dynamic access. This concept holds the advantage of being able to go into different needs, previous knowledge and learning methods of students, due its modular structure. It enables a self-controlled learning, promotes media competence and offers demanding possibilities of acting.

The first evaluation which accompanied the development of the system had positive results and constructive criticism. The entire system is to be completed by September 2000, so that the summative evaluation can be started in the winter semester 2000/01.

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NSA PARTNERSHIP WITH CAL STATE L.A.: COURSEWARE CONVERSION AND EVALUATION PROJECT

Penelope Semrau, Ph.D.
Educational Foundations & Interdivisional Studies

Barbara A. Boyer, Ph.D.
Art Department
California State University, Los Angeles
United States
psemrau@calstatela.edu
bboyer@calstatela.edu

Abstract: CSULA was charged with assisting the NSA in the research, development, documentation and the necessary expertise to convert a traditional face-to-face platform course to a multimedia web-based course. We converted a platform-based course taught by the NSA called "EEO 100: Equal Employment Opportunity Law and Diversity Training for Selection Boards." To accomplish the task, an interdisciplinary team of graduate and undergraduate students from Instructional Technology, Art Education, Computer Science, and Design collaborated on producing the website.

Constructivism

Recent studies in education have promoted the constructivist approach to learning "...where students develop their knowledge through team collaboration, discuss different interpretations of a problem, and negotiate and synthesize ideas drawing from various disciplines" (Boyer & Semrau, 1995, 14). Technology can play a significant role in this process by having students become more proactive in their own learning and more independent in their search for knowledge. Students using technology have access to ongoing real world problems, on-line dialog with scientists, and access to the latest technological advances. Ultimately, students will be engaged in their learning, see relevance in it, and take on an ownership in it. To meet the needs and interests of students, education must emphasize problem solving and application of information, instead of memorization of facts. Roberts et al state, "...students need to be able to find and use relevant information, share and discuss data and ideas, and collaborate on problem solving" (1990, 116).

Year One of Project

July of 1998, California State University, Los Angeles (CSULA) began a 3-year project sponsored by the National Security Agency (NSA) entitled "NSA Partnership with Cal State L.A.: Courseware Conversion and Evaluation Project."

CSULA was charged with assisting the NSA in the research, development, documentation and the necessary expertise to convert a traditional face-to-face course to a multimedia web-based course. CSULA students were selected to work on the project with a focus on collaborative group work and a constructivist approach to learning. An interdisciplinary team of graduate and undergraduate students from Instructional Technology, Art Education, Computer Science, and Design were brought together under the direction of two faculty members.

In this project we are converting to the web a platform-based course taught by the NSA called "EEO 100: Equal Employment Opportunity Law and Diversity Training for Selection Boards." EEO100 is directed to employees who serve or who may serve on boards, panels, or committees charged with the responsibility of rating workers for selection purposes. The course is designed to provide participants with an understanding of the extent to which their rating activities are subject to applicable civil rights laws, and to appreciate the value and contributions of every candidate. Students after taking this course will be able to:

1. Understand the requirement for EEO 100
2. Understand legal rights and responsibilities for fair and equal treatment in the decision-making process
3. Gain a common understanding of "diversity"
4. Recognize "blind spots" and conditioning from society, and how these factors impact decisions
5. Provide a hands-on opportunity to improve the decision-making process
6. Appreciate the value and contributions of every individual

Training was provided to the CSULA student team on the basics of html, Adobe Photoshop, Premiere, and Pagemill in order for them to be able to undertake the task of courseware conversion to the web. They were also trained on the use of WebCT for developing the website, uploading of web pages to website, and designing of web pages. . WebCT is an online Internet authoring tool for web-based courses. The students were guided regarding the overall layout and screen designs. For a foundation in working collaboratively in building a website the students first designed a demonstration site on streaming media—RealAudio and RealVideo. The demonstration site was developed for sharing our research and for communication among the students and project faculty. Focus was placed on developing an educational website demonstrating various applications of streaming video and audio in education as well as being a source of research data and instruction for creating streaming video and audio for web-based training.

The students investigated the hardware and software requirements for streaming media, selected examples of streaming video, and html coded web pages documenting their gathered data about streaming media and its role in web-based training. The WebCT course site also offered additional built-in communication features including e-mail, chat rooms, a bulletin board, and white board. Students used the bulletin board to provide help to each other and to assess each other's web pages.

For the foundational first part of our collaborative work, the students researched and structured their content on streaming media into the following sub-areas:

1. Introduction to Streaming Media
2. How Does It Work--Streaming Video?
3. How Does It Work--Streaming Audio?
4. Aesthetics of Streaming Video
5. Aesthetics of Streaming Audio
6. Educational Applications of Streaming Media
7. Our Examples of Streaming Video
8. Project Report 1998-99
9. About Us

Each student was charged with the design, structure, research, and development of one content sub-area.

Year Two of Project

During the fall, 1999 we moved onto converting the EEO 100 course content into a web-based course. We followed the pattern established in the prior year where each student was assigned full responsibility for the research, design, development, and coding of a topic. The EEO 100 content was subdivided into the following main topic areas: Current requirements, additional requirements, definitions of discrimination, disparate impact, harassment, affirmative action review, and tools. Each student studied and learned the EEO 100 course content and was then individually tested on it. In the process of understanding the content, they realized that it would be necessary to rewrite and revise the content, as well as integrate multimedia to accommodate a web-based learning environment. Next they html coded the EEO 100 course content and thus begun the creation of the web-based course. One of the students developed the screen design incorporating American Disabilities Association (ADA) guidelines.

They developed new test items for the content. They researched websites and selected appropriate ones related to the content and created external links to these websites. We designed draft layout for structuring the menu and content. And, we investigated, selected, and adapted a quiz format for use in this website to set up pop quizzes that were integrated within content areas.

In the winter of 2000, the students analyzed a video that was a tape of an original face-to-face traditional approach to teaching the class, which was provided by the NSA. They made a list of the video clips matching the content they were responsible for. Before we started digitizing the content, we inspected the length and filesize of each video clip to determine how to reduce the size of very large clips. We came up with several solutions which included digitizing only the audio for certain clips and accompanying the audio with still diagrams of key points and cutting up the longer clips in to shorter segments. Next the students captured the video using Adobe Premiere and the Osprey 100 video card in a Dell Precision 401 computer. They edited down the clips using Adobe Premiere. The audio was captured and edited with SoundForge. Next, the clips were streamed with RealProducer and html coded into their relevant web pages of content.

To polish off the interface design, we brought on an art student who was charged with developing an easy to use menu of topics and navigational system.

In the spring of 2000, it is our intent to synthesize various course components (content, video, test items) into a final course website and to design visual learning aids (diagrams, charts, and pictures) and tools (glossary, law books, and court cases) to enhance learning of the course content. We are preparing to design and incorporate simulations into the website. NSA has been encouraging and supportive of this idea as an extended project.

Conclusion

The new web-based version of this course will make the content accessible to more NSA employees located in various places throughout the world. Plus, the online version will include interactive pop quizzes with immediate scoring and feedback as well as streaming media lectures to complement the course content, which is presented as text on the web pages.

Through this project the students became constructively involved in their own learning and have acquired in-depth experiences in collaborative learning. The students became empowered to be creators of their own curricular materials and web pages instead of being passive viewers of others'. In this project all of Bloom's higher level taxonomies are implemented. Students are analyzing websites, synthesizing criteria that they have researched, applying their book readings, comparing and contrasting their criteria, designing and producing their own web pages, and more.

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The Internet Chemistry Set: Web-based Remote Laboratories for Distance Education in Chemistry

Frederick A. Senese
Dept. of Chemistry, Frostburg State University, USA (senese@antoine.frostburg.edu)

Christopher Bender
Dept. of Chemistry, Frostburg State University, USA (bender@antoine.frostburg.edu)

Abstract: The convergence of modern data acquisition technologies with the Web's interactivity, connectivity and multimedia capabilities presents an exceptional opportunity for distance education in the physical sciences. Web-mediated access and control of laboratory equipment can improve utilization of expensive and specialized instruments, facilitate collaborative data sharing and analysis, and provide essential practical experience in physical science courses delivered at a distance.

This paper describes a remotely controlled experiment for determining the rates of fast chemical reactions. The experiment is not a simulation; it involves actual equipment controlled in real time from remote locations on the Web. The experiment is the first in a series designed to provide a pedagogically on-line laboratory experience for Web-delivered general chemistry courses. Students use the experiment's Web interface to collect data, to obtain interactive technical support and background information, and to display and analyze results. Each experiment is designed to encourage sharing of data and collaboration with users at other institutions, providing students with a valuable first look at work in a distributed laboratory environment.

Introduction

Chemistry is an experimental subject. Chemists construct knowledge by systematically examining quantitative data for patterns. Patterns suggest hypotheses, which in turn form the basis for theories. Theories are then critically evaluated in the light of new experimental data. This is the only sanctioned approach for progress in science. Pedagogy that is not founded on the interplay between theory and experiment poorly serves students by not involving them in the essential process of science.

The experimental nature of chemistry presents severe challenges for teaching the subject at a distance. Many current online chemistry courses either have no laboratory experience at all or use simple kits or 'kitchen chemistry' experiments that can be performed with household materials. Obtaining accurate, quantitative data from which relevant and interesting conclusions can be drawn is difficult with such simple equipment.

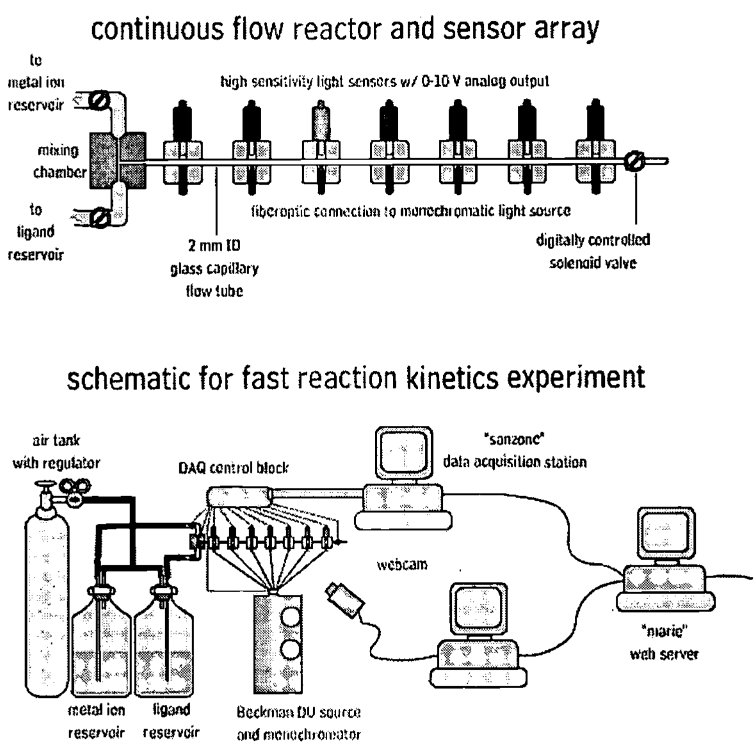
Online chemistry courses often make heavy use of simulations. While simulations can be quite effective, they are theoretical constructs that cannot substitute for practical experience. For example, students regarded the output of simulations in a statistical analysis experiment at Oxford University as "pretend" data (Cartwright, 1998). They sometimes failed to carry over the lessons learned from analyzing simulated data to data collected in actual experiments. Concerns about the pedagogical quality of the simulations were addressed by the development of a simple, economical "optical rig" (Cartwright, 1999), which allows students to collect and analyze actual data over the Internet.

This project addresses the problem of practical experience in Web-delivered courses by providing students with remote access and control of real equipment. A remote-control reaction kinetics experiment suitable for chemistry students at the undergraduate or advanced secondary level is described. The apparatus monitors the course of a fast chemical reaction spectrophotometrically using a simple continuous-flow method. Students can use the data they collect to determine the rate laws for the reaction under a variety of conditions. By collaboratively analyzing the results of a large group of experiments performed by peers, students can propose mechanisms for the reaction. While the experiment is conceptually quite simple, it involves specialized apparatus that is unavailable in most undergraduate laboratories. Rapid data acquisition can allow many users to perform experiments in real time, and nearly spontaneously.

Method

The experiment is an adaptation of a classic continuous flow method for studying the rates of fast reactions (Dalziel, 1953; Roughton & Chance, 1963). The apparatus can be used to determine the rate of any sufficiently fast reaction that produces a colored product, although practical considerations limit the choice of reaction(Shoemaker, 1974). Pilot investigations studied the formation of $FeSCN^{2+}$ (an orange complex that absorbs at blue light at 455 nm) and "Prussian blue", an intensely colored complex used in blueprinting, paints and inks (Sharpe, 1976).

A schematic diagram of the apparatus is shown in (Fig. 1).



Reactant solutions are forced from large reservoirs into a T-shaped chamber, where they mix completely in less than 1 millisecond. The reacting mixture then travels down a long capillary tube. The product of the reaction is intensely colored and strongly absorbs a characteristic wavelength of light. Product concentration rises as the mixture moves along the tube. Seven light sensors placed at fixed positions along the tube monitor the increase in concentration. Monochromatic light is passed through the capillary at each position using a fiber-optic cable. High sensitivity photocells placed on the opposite side of the tube record the intensity of transmitted light at each point; the intensity drop caused by absorption of the light by the complex is simply related to the concentration. A flow rate sensor allows the position of each of the spectrophotometers to be associated with a reaction time.

Data from the sensors is acquired by "sanzone", a 500-MHz PC equipped with a National Instruments data acquisition card. A LabView program collects, labels, and writes the absorbance, temperature, and flow rate data to an "outgoing" queue. The program then checks for requests in an "incoming" queue. If one exists, a new run is started. Otherwise, the system is flushed and the valves are closed to avoid unnecessary waste of reagent solutions.

A Webcam collects pictures of the apparatus during the run. The camera view includes the reservoir manometer and a digital thermometer, so it is used for data collection as well as for helping students monitor the progress of the reaction. The Webcam is attached to a second PC to avoid contention.

A Unix Web server (Marie) mounts Sanzone's hard drive across the local network. Perl scripts running on Marie fetch data from the outgoing queue, interpret it, and prepare the results for display.

Students perform the experiments via a "smart" instrument panel served from Marie, displayed in a standard browser. The instrument panel recreates the actual look and feel of the remote experiment. Operators immediately see the results of their actions via the Webcam, as well as on a rich data display. The panel's panic button launches a conferencing connection with the system's caretaker via Netmeeting during working hours and by email at other times. The panel monitors and interprets student activity to diagnose and correct conceptual problems and to prevent actions that could damage or tie up the apparatus for long periods of time.

The instrument panel front end is implemented in JavaScript and Macromedia Flash. When students submit a run from the instrument panel, backend Perl scripts label and process the request and write it to an "incoming" queue on Sanzone and the expected time of completion for the job is displayed on the panel. Jobs complete within a few seconds when the incoming queue is empty. Queues are intelligently managed by consecutively scheduling jobs with similar operating parameters and by assigning lower priority to non-local IP addresses (to prevent 'walk-in' users from monopolizing the experiment).

Future versions of the experiment will allow students to manipulate additional parameters, such as reagent concentrations, pH, temperature, ionic strength, and flow rate. Data from different groups can then be pooled and analyzed. Students will then use these results to evaluate proposed mechanisms for the reaction. Further developments will be outlined on the project home page at http://antoine.frostburg.edu/chem/senese/inetchemset.

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A Distance-Learning Model Based on Web Mining

Ruimin Shen
Qijun Wang
Dept. Of Computer Science and Technology
Shanghai Jiaotong University, Shanghai, 200030, P.R.C
Email: rmshen@mail.sjtu.edu.cn

Abstract: Distance-Learning based on WWW has become a trend for the development of education. But the distance-learning site based on WWW is static, the designers of the courses don't know whether the design of courses is rational or consistent with the teaching law. While there is a lot of students' information accumulated in the web site, and the information is useful for our course designers. In this study, we present a distance-learning model based on Web Mining, which can take advantage of those students' information accumulated in the web site.

1.introduction

Distance-learning based on WWW has become a trend for the development of education. The available distance-learning model based on WWW is discussed in (Xuejun Li 1999). But recently the distance-learning site based on WWW is static, and the designers of the courses don't know whether the design of courses is rational and consistent with the teaching law. While there is a lot of students' information accumulated in the web sites, such as students' access patterns and registration and communication data information, and these information is useful for our course designers and teachers.

In this study, we present a distance-learning model based on Web Mining, which can take full advantage of those students' information accumulated in the web sites.

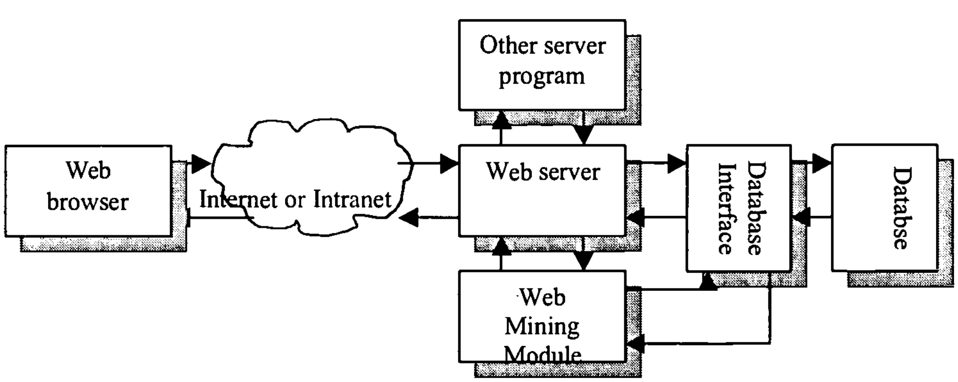
2.A Distance-Learning Based on Web Mining

The model integrates the Web Mining technology into the available model base on WWW. It's architecture is shown (Fig.1). In this model, we add the Web Mining module into the available model. The Web Mining model is located in the server-side and performs in the server-side.

According to our special system for distance learning, the Web Mining process as shown in (Fig.4). The Web Mining module has three phases(Robert cooley et al. 1998): Preprocessing(Yilin yang et al.1999), mining process and pattern analysis.

3.Conclusion

our model has following points: The course designers can reconstruct a Web sites in order to better serve the needs of students of a site according to these information such as the students' access patterns and page access frequency statistics; it can provide individualised page or different course content for individual student; and it can provide teachers the students' feedback, and teachers can redesign their teaching plans,too.



Client-side Server-side

Figure 1. A Distance-Learning Model Based on Web Mining

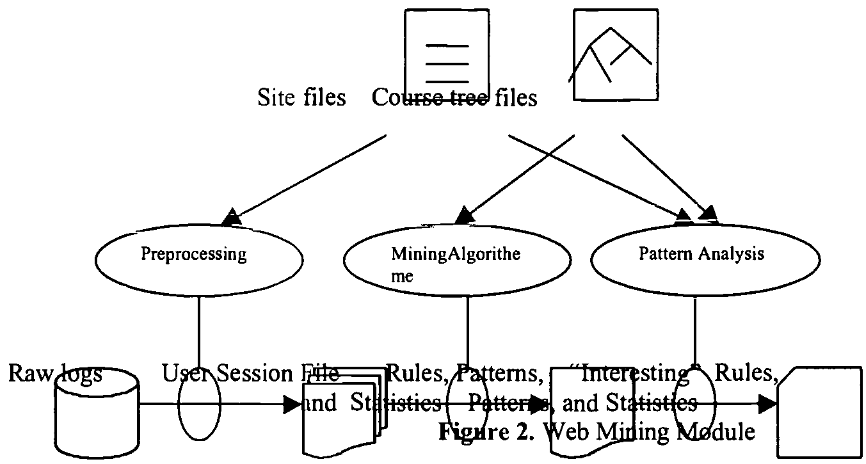


Figure 2. Web Mining Module

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Scenario-Based Prototyping: a User-Centered Method for the Design of CALL Systems

Jae-Eun Shin
Department of Computer Science
University of Manchester
United Kingdom
jshin@cs.man.ac.uk

David G. Wastell
Department of Computer Science
University of Manchester
United Kingdom
dwastell@cs.man.ac.uk

Introduction

The aim of this paper is to illustrate and demonstrate the value of a user-centered method for CALL systems development. We accept the argument of Hubbard (1996), Levy (1997) and other the deficiencies of current CALL system can be attributed to the lack of a systematic methodological theory guiding their design. Accordingly, a CALL design method has been developed which draws on recent developments in the field of human-computer interaction regarding scenario-based design and prototyping in relate to the user-centered design of computer-based learning material.

Scenario-Based Prototyping

The main features of the method include the use of scenarios to identify user requirements (Carroll, 1995), the development of prototypes embodying key design issues, and a series of formative workshops to evaluate the prototypes. The overall results confirm the general validity of the user-centered, scenario-based methodological approach.

There were three cycles of prototyping process in this research. Each cycle was based on a set of User Satisfaction Scenarios. The scenarios were used to build prototypes in two different ways: user dissatisfaction scenarios were used to define existing problems that have been found from the current CALL products; and user satisfaction scenarios were used to clarify possible problems that could be found in the CALL product to be built. A template for scenarios is proposed for the educational environment. The template include the user environment (i.e., age, school, class, user's conception toward CALL system, motivation of using CALL software, software type), learning environment (i.e., classroom, self-studying, group-studying), and narrative user interaction scenario to define features user satisfied/dissatisfied. Overall, this paper is to suggest the method of use of scenarios explicitly for designing CALL systems, not to show the results of prototypes which have been constructed and evaluated

Developing prototypes is an integral part of iterative user-centered design process because it enables designers to try out their ideas with real users and to gather feedback. There were three major cycles of prototyping process with different prototypes embodied different design issues, which is based on user-satisfaction scenarios. The main design issue of the first prototype systems was to find how user-control could affect to achieve high quality CALL systems in terms of both educational and technical value. Two comparative systems were built for this initial stage: one was a high user-control (learner-based) system, and the other was a low user-control (teacher-oriented) system. According to the feedback from a series of formative user workshops, it has been found that the effectiveness of user-control were dependent on learners' experience in CALL systems and their learning environments. Based on the feedback from the first workshops, the user satisfaction scenarios were revised to find the design issues for the second prototype.

The second prototype system was a hyperlink system between three different systems: Tutorial system for listening skills with low user-control, Main Lesson system for practicing listening skills with high user-control for experienced users, and a sub-system called Speaking Dictionary to provide learners linguistic help. The user response about the hyperlink system was that it would be better to have a different user-control by learning stages concerning user experiences. Users also showed positive opinions about the user satisfaction scenarios because they agreed that scenarios make it easy to visualize the real-world environment and to comprehend users' perspective toward CALL systems. On the other hand, users responded that learners need more support to control their learning process more effectively.

Therefore, the third prototype constructed was focused to investigate the effectiveness of Teaching Agent to support learners' learning process with respects of HCI aspects and educational achievement. At this stage, we argue that TA should have domain knowledge (i.e. English), Training knowledge (i.e. listening skills), and Specific pupil knowledge. Here, the specific pupil knowledge is the most significant to advise learners what to do next. While the knowledge of domain and training are static and independent on student or teacher, the knowledge of specific pupil depends on followings: how well is the learner doing?; what listening skills have been used?; what personality does the learner have?; and what is the learning goals? The TA system called Magic Mirror has been developed to apply those aspects based on the revised user satisfaction scenarios, in which learner personality and learning goal of specific pupil knowledge were not considered. The result from the third workshop with teachers was positive towards the concept of TA in general, but some teachers questioned how TA could act as a substitute for a teacher. On the other hand, learners showed more positive attitude towards the TA because they compared the TA with Help functions in other CALL system, not with their teachers. The conclusion is that TA could make CALL systems more effective if all the aspects of the specific pupil knowledge are regarded on the development.

Conclusion

The essential elements of this user-centered method for designing CALL systems are scenarios, prototypes, and formative workshops. Prototyping helps designers to make user-oriented decisions by eliciting information from the formative evaluations of users, and scenarios are useful to articulating new design concepts like TA. In HCI practice, *scenarios of use* are increasingly being used to help set overall design objectives for guiding various aspects of the design process. Carroll (1995) argues that if we believe the scenario approach to be a valuable enhancement of current development practice, we must ask how the use of scenarios in system development can be evoked, supported, and brought to bear on various activities within the system development cycle. Overall, this user-centered method is very effective regarding the following aspects. Firstly, Scenarios are used as a bridge between designers and users to define learners' or teachers' needs and learning environment in order to achieve learning goals. Secondly, prototypes are used to apply design issues and to demonstrate the expected learning environment concerning pedagogical value. Finally, user workshops are held to investigate user satisfaction to evaluate design issues and principles in terms of both technical and educational value.

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Flexibility and Facilities In Children's Electronic Textbooks

Norshuhada Shiratuddin
Department of Information Science, University of Strathclyde, Glasgow, UK
shuhada@dis.strath.ac.uk, shuhada@uum.edu.my

Monica Landoni, PhD
Department of Information Science, University of Strathclyde, Glasgow, UK
monica@dis.strath.ac.uk

Abstract: Design of electronic books should take into account the diversity of learning styles, intelligences and preferences of each user. This project main aim is to provide high level of electronic book interaction and flexibility by matching different categories of electronic pages (graphic page, talking page, hypermedia page and web page) to the different learning styles. Each page exhibits programs and activities that attempt to cater for each learning style. The same content in each page will be presented in four different presentation modes. In addition to the technical system development, a conceptual model of children's electronic textbook will also be proposed. This model is based on Howard Gardner's theory of Multiple Intelligences and Philip Barker's generalization of electronic books model.

Introduction and definition of electronic book

Educational environment stresses the importance of reading materials: textbooks, reference books, encyclopaedias, magazines and newspapers as media of knowledge carriers. Hence converting printed publications especially textbook into interactive electronic form should prove to be extremely useful and helpful. There are various definitions of electronic book (e-book). Bonime et al. (1998) described any kind of information ranging from a CD-ROM title to an online interactive database including collection of web pages as electronic book. Barker (1998) defined e-book as essentially a computer-based information storage that embeds a book metaphor. More precisely (Barker, 1999), e-book is usually considered to be composed of a collection of reactive pages of electronic information that are organised in a thematic way and that exhibit many of the characteristic features and properties of a conventional book. Barker categorises e-book into ten types depending on the types of information embedded: textbooks, picture books, talking books, moving picture books, multimedia books, polymedia books, hypermedia books, intelligent books, telemedia books and cyberbooks. While Barker categorises ten types of e-book, Landoni et al. (1993) classified e-book according to three different criteria: books which are portable (e.g. personal digital assistant), books which preserve the logical structure (i.e. chapters, sections and subsections) and lastly, books that support both the physical and logical aspects of a paper book. In context of this project, definition of an e-book will be defined when the study is completed.

Research Question

Children learn in different ways. There are many theories on how people learn and one example is the Multiple Intelligences (MI) theory proposed by Howard Gardner (1993). This theory states that there exist seven intelligences (thus seven learning styles): verbal/linguistic, logical-mathematical, visual/spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal (to date, two more intelligences have been added). Based on this theory, Armstrong (1994) wrote a book on how to apply this theory into the classroom environment. He identifies that each child could learn in any one of these ways or through a combination of several ways. With these different learning styles, design of e-books should take into account these diversity and attitudes of each user particularly young children. Thus, one question can be extracted: how to give young children better flexibility so as to cater their differences?

Proposed Solution: Giving E-Book Flexibility

There are many methods to give flexibility in e-books. One example is by providing tools or facilities, which can be used by users while consulting the e-book. Landoni et. al (1993) in her project provided users with facilities such as personalisation (highlighting, bookmarking, note taking), searching through TOC table of content and index, and printing. Other examples include providing system adaptivity, supporting for group-based learning, considering the likelihood that teachers will use the program in class and including different levels of contents in the books.

It is the intention of this on going project to suggest that another method to achieve flexibility is through flexible presentation modes that include programs and activities which match each learning style. The following gives few examples on how to match MI theory to the existing e-book model:
(a) Verbal/linguistic – Is matched with e-book concept of *hypermedia page* through programs such as letting users create essays, read aloud and include storytelling.
(b) Visual/spatial – Is matched with e-book concept of *graphic page* through programs such as letting users draw and paint and allowing users to read and see information as graphics, maps, charts and diagrams.
(c) Musical – Is matched with e-book concept of *talking page* through programs such as combining stories with songs and letting users sing along.
(d) Interpersonal – Is matched with e-book concept of *web page* by including programs, which need two or more users at the same time and group project or discussion.

Proposed electronic book model

Page = Contents + [Object A + Object B + Object C + Object D]
Object A = Graphic page + {Program G1 | Program G2 | …| Program Gn}
Object B = Talking page + {Program T1 | Program T2 | …| Program Tn}
Object C = Hypermedia page + {Program H1 | Program H2 | …| Program Hn}
Object D = Web page + {Program W1 | Program W2 | …| Program Wn}

Conclusion

In conclusion, our e-book shall exhibit four different concepts and include a number of presentation modes and styles, in order to provide readers with a high level of flexibility. Users can choose between the four different presentation modes when he/she opens any page. Upon completion, this project will be used to prove these assumptions:

H1:It is possible to address diverse learning styles by providing users with flexible presentation modes of each page.
H2:These flexible presentation modes are probably more appropriate to use and as such give e-book high level of flexibility.
H3:It is then possible to suggest that due to this high level of e-book flexibility, users are more likely to prefer this type of e-book.
H4:If H1,H2 and H3 are proven, then we could postulate that an additional desirable feature for e-book would be to present contents by mixing many presentation modes.

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What Is So Revolutionary About The Internet In Education?

Peter B. Sloep, Ellen Rusman
Educational Technology Expertise Center, Open University of The Netherlands
The Netherlands
peter.sloep@ou.nl; ellen.rusman@ou.nl

Abstract: The Internet is making inroads into almost all quarters of our society. Education is no exception to that, nor should it. Exciting new ways of building content, of delivering it, of interacting with our students, indeed of managing our educational 'industry' can be seen to evolve. Even if one may not wholeheartedly support all these innovations, particularly for all those with an inquisitive mind it is inspiring to see education being rethought in so many and fundamental ways. Or is it?

The Internet revolution clearly is a technological revolution. It pushes developments in various fields, education being no exception to that. However, are the new technologies used to innovate education, that is, to bring about a genuine transformation; or do they just substitute older technologies for new ones?

An educational model that is widely implemented these days - although it doesn't alway go by this name - is that of the *extended classroom*. As the name suggests, an extended classroom takes the ordinary classroom as its starting point and extends it, mainly spatially. So the dominant didactic model here still is a teacher who addresses a group of students; students and teacher are simultaneously present; the teacher takes the lead; students may ask questions but those only serve to clarify the exposition of the teacher; students seldom interfere with the choice of content, which is the teacher's exclusive realm; students hardly ever have a say in the didactics used, this also is the teacher's prerogative. In the extended classroom, teacher and students may be in different locations, the distance being bridged by television, videoconferencing, audiographics and similar technologies. Put extremely, with the extended classroom one aims to mimick a regular classroom to the largest possible extent. Hence the call for ever larger bandwith, for systems that allow for 'natural' interactions between the teacher and the remote classroom, etc.

However cleverly designed our communication systems, however large our bandwidth, extended classrooms will always be second best, a substitution for the real thing, only useful as a means to reach out to the remote student, perhaps to serve larger groups of students and achieve some economy of scale. Lecture notes that are being put on the web as a service to the students, or e-mail and newsgroups that deliver additional support only serve to underline the main conclusion: in the extended classroom technology is used to substitute or augment existing teaching modalities.

Obviously, there is nothing inherently wrong with this. Technology is a means to an end and should be used accordingly, that is, how *we* see fit. However, if it is our lack of imagination or if it is the rigidity of our institutions that prevent us from using technology in more creative ways, then we should not rest content. We should reexamine our educational practices and ask ourselves to what extent they were limited by existing technologies and to what extent the new technologies empower us to innovate. And indeed, it is our claim that we only stand at the beginnings of truly innovative educational practices and genuinely new didactic principles.

Distributed learning is a term that is often used in this context. In distributed learning systems, there are no classrooms anymore, no teachers offering students prepackaged chunks of education carefully aranged to conform to the needs and capacities of the average student. Students now occupy center stage, assembling and arranging content that fits their specific needs; they take it in when and where it suits them best, perhaps in a didactic style that optimally matches their learning style. The role of the teacher now is not communicating knowledge, but to make it available, to empower students via intakes and assessments and help them assimilate knowledge, to offer custom support. In distributed learning, technological innovation is not the push behind educational innovation, as is the case in the extended classroom. Rather, the converse holds true, educational innovation pushing technology. And indeed, distributed learning requires specific technologies that extend beyond the mere facilitation of communication. Technologies are needed for creating learner centered content, for the delivery of such content, for flexible intake and assessment procedures, for portfolio management, etc. In our presentation we will discuss these technologies at some length.

Online Mentoring: A Case Study Involving Cognitive Apprenticeship and a Technology-Enabled Learning Environment

Kathleen Snyder, Applied Learning Sciences, IBM T.J. Watson Research Center, U.S.A.
ksnyder@us.ibm.com

Robert Farrell, Applied Learning Sciences, IBM T.J. Watson Research Center, U.S.A.
robfarr@us.ibm.com

Norma Baker, Project Executives Programs and Support, IBM Global Services, USA
njbaker@us.ibm.com

This paper describes a study aimed at investigating the impact of a technology-enabled training program for Project Executives (PE's) in the IBM Corporation. The program is focused on a mentoring approach to learning whereby PE's considered to be experts in specific skills coach less experienced colleagues in the development of critical skills. Since job demands prevent ongoing face-to-face mentoring relationships, technology which enables collaboration at a distance is implemented to support the mentoring relationship. Of interest in this study is the effectiveness of instructional design approach, the impact of the technology-enabled learning environment on sustaining mentoring relationships, and the nature of online discussions between experts and students.

IBM PE's are responsible for managing large information technology contracts. These professionals deliver on commitments to customers, ensure customer satisfaction, secure business opportunities, and mentor other project executives. Their role of mentor is critical to the professional development of less experienced colleagues. While traditional face-to-face mentoring is desired and encouraged, job demands often prevent mentors and students from sustaining the type of relationships needed for the transfer of critical skills.

In the current study, a combination of face-to-face instruction and a technology enabled learning environment is used to develop and sustain mentoring relationships among expert PE's and less experienced colleagues. The face-to-face instruction includes a two day workshop consisting of five sessions led by the expert PE's. The purpose of the workshop sessions is to 1) initiate a mentoring relationship among expert PE's and a group of colleagues and 2) to begin the mentoring process which includes the transfer of a specific set of problem-solving skills.

At the conclusion of the workshop participants are introduced to *e-mentor*, a Lotus Notes discussion database which can be accessed using a Lotus Notes Client or a Web browser. The discussion database is used to provide an online learning environment in which the mentor-protégé relationship is preserved. Mentors post mini-lessons on topics relevant to the development of complex problem-solving skills needed in customer situations. Participants respond to the lessons in discussion format, post questions and collaborate with one another in solving customer problems. Mentors are available to assist participants with appropriate strategies for addressing customer problems.

The instructional design approach used in the workshop and online is based on cognitive apprenticeship, an instructional approach developed by Collins, Brown and Newman (1989). Cognitive apprenticeship focuses on the development of higher level thinking skills such as problem-solving. Because of its focus on the teaching of cognitive and metacognitive knowledge, cognitive apprenticeship may be a more appropriate instructional design model for online mentoring than more traditional instructional designs such as a lecture approach. Whereas text and lecture-based instructional design models focus on teaching concepts, facts, and procedures in non-situated environments, cognitive apprenticeship focuses on teaching the processes and strategies used in expertise and how this knowledge is used to solve real-world problems. Snyder (2000) demonstrated the effectiveness of cognitive apprenticeship as an instructional design approach for teaching technical skills in an online environment.

Collins, Brown, and Newman (1989) and Collins (1991) identify four aspects of cognitive apprenticeship learning: content, instructional methods, sequencing of instruction, and sociology. Content refers to the different types of knowledge required for expertise and includes domain knowledge and strategic knowledge. Domain knowledge consists of concepts, facts, and procedures; strategic knowledge refers to knowledge which underlies an expert's ability to make use of concepts, facts, and procedures to solve problems.

Instructional methods are the learning activities used during instruction to help students construct, use, manage, and acquire new knowledge (Collins, Brown, & Newman, 1989). Seven instructional methods are recommended. These methods include teachers "modeling" skills, "coaching" learners as they attempt to mimic expert skills, providing "scaffolding" in the form of support for learners, and gradually "fading" support, as learners become more proficient. Learners are also encouraged to "articulate" their knowledge, "reflect" on their problem-solving processes, and "explore" new approaches to problem solve on their own.

Sequencing involves the staging of learning whereby tasks are presented in increasing complexity and diversity so that students develop a broad understanding of the domain of expertise. Sociology deals with the authenticity of the learning environment. Technological, social, time, and motivational characteristics of real-world situations are designed into the learning environment so that students will learn when, where, and how the knowledge applies to other situations (Collins, Brown, & Newman, 1989).

The PE workshop in this study and the e-mentor database are designed to incorporate the four aspects of cognitive apprenticeship learning. In the workshop, learning takes place in the context of solving a variety of real-world complex customer problems. Mentors begin sessions with an introduction a complex customer problem. Facts and concepts about the customer environment are presented (domain knowledge) and followed by modeling of the strategies and processes used to solve the problem. During this activity, mentors use think-aloud protocols to model the strategic thinking required to solve the problem. Next, tips and techniques (scaffolds) for remembering the processes and strategies are provided to students. Students are then assigned to small teams of six and work together to develop a solution to an existing customer problem. The problems used in this exercise are real-world and are brought to the workshop by students. Students are required to articulate the processes and strategies used to address the customer problem and then briefly explore alternative approaches to problem-solving. At the conclusion of this exercise, mentors model their thinking with respect to solving the team problems. When the two-day workshop ends, the mentor- protégé relationship is maintained using the Lotus Notes discussion database. Workshop participants use the database to request help from colleagues and mentors regarding problems experienced in the workplace. Mentors use of the cognitive apprenticeship method when responding in the online environment.

The results of this study to date have been successful in that this combination of face-to-face and online mentoring has enabled a community of IT executives who are geographically dispersed to form working relationships and share knowledge on a regular basis. This model has also provided participants with an environment for continuous learning on a just-in-time basis, convenient to their demanding work schedules. The instructional design approach has been notably successful in providing an effective way for PE's to learn new skills. Participants in the workshop quickly adopted the habit of thinking about problem-solving from a strategic perspective (that is, identifying the processes and strategies needed to solve customer problems and using reflection and exploration techniques before identifying a solution). This learning approach has also provided a common ground for PE's to work together to solve customer problems. Results of a survey administered to participants of the workshop indicated high ratings with respect to the methods fostering working relationships among PE's, the value of the content of the workshop, its structure (instructional design approach) and the value of the e-mentor database in providing a continuous learning environment which facilitates collaboration.

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An Online Environment that Scaffolds Moving from Novice to Expert Collaborative Learners

Joseph B. South
Center for Instructional Design
Brigham Young University
Provo, UT 84606
Joseph_South@byu.edu

Laurie Miller Nelson
Instructional Psychology and Technology Department
Brigham Young University
Laurie_Nelson@byu.edu

Digital Learning Environments Research and Development Group
Brigham Young University

Abstract: This work-in-progress paper describes a pedagogical approach to designing an online collaborative learning environment that scaffolds learners in becoming better collaborative learners. This environment is based on Collaborative Problem Solving (CPS) instructional theory. The paper will overview the need for the environment, and the design principles used to design and develop it.

Need

As online education becomes more prevalent as a system for distance education, a need arises for an online structure that supports instructors and learners engaging in small group collaborative problem solving or project work at a distance from one another. Particularly, there is an increasing need for online learning environments that support effective, efficient collaborative processes, such as those used by expert group problem solvers.

When online environments impose restrictive structures or do not account fully for these processes, they may hinder the flow of learning, and curtail effective, efficient problem solving. Most online environments that attempt to use collaboration as a learning strategy incorporate a smorgasbord of communications technologies that are not structured according to research into the most effective ways to scaffold effective collaborative interactions. Furthermore, the applications included in these systems (such as email, threaded discussions, and file storage) are generally lower-level communication tools as opposed to tools that could support robust collaboration. Because they do not use a guiding theory that is pedagogically based, the resulting interaction often do not adequately address the social, intellectual, and logistical complexity of effective collaborative learning. This is partially due to the fact that until recently, no comprehesive theory capable of support effective online collaboration existed.

Specifically, the weakness of these approaches is their primary reliance on a document-based paradigm (such as Lotus QuickPlace or Hyperwave), conferencing-based paradigm (such as Microsoft NetMeeting or Lotus Sametime), or room-based paradigm (such as BioMOO or Diversity University) (Miao, Fleschutz, & Zentel 1999). For the design to fully support a cohesive collaborative learning approach, the strengths of each of these approaches must be synthesized into a context-based system that allows for a more flexible combination of people, places, tools, documents, and interactions than these other types of systems afford, thus providing robust support for the communication, collaboration, and coordination necessary to learn effectively as a small group.

Proposed Solution

We propose to design, develop, implement, and evaluate an online collaborative learning environment that both supports pedagogically sound instruction and provides appropriate scaffolding for moving learners from novice to expert collaborative learners. It will be based on Collaborative Problem Solving (CPS), an instructional theory designed for effective, efficient small-group problem solving (Nelson 1999). This theory outlines a detailed collaborative learning process derived from a series of carefully documented case studies of expert learning groups integrated with findings from current research in areas such as small group dynamics, cooperative learning, and problem-based learning. The goal of this theory is to provide step-by-step scaffolding to both instructors and learners that will help learners make the difficult transition from novice to expert collaborative learners.

Unlike existing tools that merely provide a collaboration platform, this online system will be designed to serve as a robust teaching and learning environment that will provide guidance for both instructors (in designing their instruction and in appropriately monitoring, supporting, and assessing the learners' progress) and learners (in developing effective collaborative skills while learning at a distance). This learning environment will be capable of scaling to any number of small groups and will support instruction in a variety of disciplines desiring to engage learners in project- or problem-based learning around complex, real-world problems. Its structure will afford support for every phase of effective small group collaboration, from building readiness to providing closure, by providing all the collaborative learning spaces, tools, and resources necessary to do so, such as "just-in-time instruction" for learners as they progress through the given project or problem scenario.

Project Goals

The goal is to create an online learning environment that has the following features and characteristics:

- Teaches and supports the nine phases, not just isolated activities, of Nelson's effective collaborative problem solving process, which includes: building readiness, forming and norming the groups, determining a preliminary problem definition, defining and assigning roles, engaging in an iterative collaborative problem-solving process, finalizing the solution or project, synthesizing and reflecting, assessing products and processes, and providing closure to the learning experience,
- Employs proven pedagogical theory and arrays tools around this theoretical structure,
- Responds to the needs of the users by being flexible, customizable, and reconfigurable,
- Runs entirely on open standards-based Internet protocols,
- Enables distributed groups to learn and work together at least as effectively as co-located groups,
- Provides guidance for both instructors and learners in effective collaborative learning, and
- Archives the work of small groups for both the group's reference and for research analysis.

Project Design

Our design approach is to translate each element of CPS theory into a corresponding aspect or structure of the environment, such that it both implicitly and explicitly supports effective, efficient collaborative problem solving philosophy and methods. From this blueprint, we will work with a software designer to create a data model. From the data model, the software designers will create a database-driven, internet-based collaborative environment that will scale to any number of small teams. Simultaneously, we will begin a paper prototyping phase to determine the initial visual design, working with a target user pool of instructors and students at the two distance education entities. We will then employ a rapid prototyping method to improve our visual design and address the usability issues of instructors and learners testing alpha versions of the system. Once we have a beta quality environment, we will conduct pilot studies with instructors and learners in diverse content areas and geographical locations. Finally, we will evaluate case studies of the system fully implemented in a variety of learning, work, and research settings and use the data to refine a final version that we will release for use on the local servers of any interested partners.

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Technology Learning Communities: Collaborations to Increase Technology Integration in Education

Mary L. Stephen
Department of Arts and Sciences
Harris-Stowe State College
St. Louis, MO
USA
stephenm@acm.org

Diane M. Smoot
Department of Arts and Sciences
Harris-Stowe State College
St. Louis, MO
USA
smootd@hssc.edu

Abstract: This paper describes the implementation of a pilot project involving the formation of networked technology learning communities designed to nurture the growth and sharing of expertise in meaningful uses and integration of technologies into teaching and learning among college faculty members, student teacher candidates and classroom teachers. The paper focuses on issues related to the establishment of technology learning communities and includes brief studies of selected members of the learning communities.

Introduction

Recent studies (Trotter, 1997; U.S. Department of Education, 1998) indicate that a large majority of classroom teachers in the U. S. continue to feel inadequately prepared to integrate technology into classroom instruction. This work-in-progress paper describes the implementation of a pilot project that focuses on ways to address this problem. The project involves the formation of networked technology learning communities designed to nurture the growth and sharing of technological expertise among college faculty members, teacher candidates and classroom teachers in the integration of technologies into teaching. The project studies potential for such communities to enlarge the number of technologically proficient current and future teachers by increasing the number of college faculty members who model the use of technologies in their teaching, the number of teacher candidates exposed to technology-proficient college and classroom teachers, and the pool of technologically proficient classroom mentor teachers. Ultimately, the goal for this project is to support a cycle of increased meaningful integration of technology into teaching.

Technology Learning Communities

Technology learning communities provide "a culture of adult learning and mutual support" (McKenzie, 1999, p. 71) that enable individuals with different skill levels to assist each other in the learning of ways to integrate technologies meaningfully into teaching. Technology learning by members occurs in both informal and formal settings, with support and expertise provided when requested by members of the communities. These communities sustain the different learning styles of the members. The strength of a learning community lies in the emphasis on members teaching each other what needs to be learned and at a pace that meets individual needs and preferences (McKenzie, 1999). Emphasis in the pilot learning communities is on supporting projects that have a direct impact on teaching and learning.

Inherent in the formation of learning communities with membership from diverse groups, i.e. college faculty, college students, and classroom teachers, are many challenges. If a learning community is to be successful, membership must be "flat and non-hierarchical" (McKenzie, 1999) in the sense that all members are equal partners. Ideally, the learning communities should have an impact on education that radiates beyond the communities. The focus of each member of a community must be on ways to use technology to improve teaching, not simply on the development of individual technological expertise. Members of a learning community must accept the responsibility to take the acquired skills and knowledge back to their circle of professionals. Each member must be willing to build on acquired skills and knowledge, even after the pilot project ends.

Each ten member learning community in this project is composed of college faculty members, teacher candidates, and preK-5 teachers, with varying degrees of technological expertise. Criteria for membership were established prior to the formation of the learning communities. Student members were selected based on meeting those criteria and documented faculty support for their membership. Faculty members and K-5 teachers meeting the criteria and having a range of technological expertise were identified and invited by project leaders to participate in the project. The members of the current learning communities appear to have successfully established a non-hierarchical relationship partly due to the selection process. Each member of the learning communities is equipped with a laptop computer and Internet access to facilitate collaboration.

In the initial meeting of the learning communities, members were surveyed on their levels of technology expertise and discussed their learning expectations. This information assisted the coordinator of the learning communities in planning group learning sessions. In addition to these face-to-face meetings, members of the communities interact using email and a discussion list. The discussion list, TechTalk, provides a mechanism for members to share and request resources, and to obtain fast response to technology-related inquiries. With support from learning community members, the college faculty members are increasing technology use in the courses they teach. The teacher candidates have the opportunity to assist in the implementation of technology-based lessons, to design lessons and materials to be used during student teaching with preK-12 students, and to work with the college faculty members as they integrate technology into courses. The classroom teachers are sharing and expanding their expertise in integrating technology into the preK-5 curriculum.

Members of the learning communities have formed partnerships as reflected in interviews done with one student and one faculty member in the communities. Faculty Member A is a beginning technology user, though she is knowledgeable about the Internet. As a college history professor, she wants to explore the use of the Internet not as an electronic library reflected in the web sites that she includes in her syllabus bibliography, but as a vehicle to encourage her education students to think critically about events in history. She finds the learning communities helpful in learning about social studies issues important to elementary teachers but receives the most help from one-on-one tutoring from individual members. She is especially appreciative of the help from Student B, an above average technology user, who acquired many of her skills at the college. In addition to tutoring Faculty Member A, Student B is helping two classroom teachers in her learning community to teach their students HyperStudio. She finds that the learning communities aid her goal of being a teacher because through this collaboration she is spending time in a classroom setting working with children.

Evaluation of the progress being made by members of the learning communities in meeting the initial goals of this pilot project is encouraging. This project is providing the groundwork for modification and expansion of future technology learning communities.

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Four Challenges for TeleTeachers in Rural Schools

Ken Stevens, Memorial University of Newfoundland, Canada

The introduction of telelearning in schools in Canada, as in other developed countries, has been particularly noticeable in rural areas and has been influenced by declining school enrolments. There are four challenges common to the technological enhancement of rural schools: the building of appropriate infrastructures, the location of appropriate technologies, the development of pedagogy for teleteaching and the need for on-going professional development.

Challenge One: Building Appropriate Structures (Digital Intranets)

By constructing web-sites both teachers and students in a rural school can enable people located almost anywhere to connect with them and learn about their programs and activities. In Canada regional and national educational networks link classes in schools on dispersed sites. Stem-Net in Newfoundland and Labrador in eastern Canada is the provincial arm of the federal SchoolNet System. These federated electronic structures enable teachers to extend the curriculum available to learners in dispersed and, often, very isolated sites. Schools in rural Canada are developing open and flexible academic and administrative structures as they electronically link with one another. These new structures exist within the traditional and, by comparison, closed school systems in each school district. In the open educational structure of teleteaching within digital intranets, constructed to link schools for the delivery of specific courses for some students, participating institutions academically and administratively interface for that part of the school day during which classes are being taught. This is a very different educational structure from the traditional and, by comparison, closed educational environment of the autonomous school with its own teachers and its own students. In Canadian networks such as Stem-net, each site becomes an inter-dependent part of a virtual school, without which it could not provide all the courses that local people are increasingly accessing.

Challenge Two: Finding Appropriate Technology

As schools become teaching and learning sites within digital Intranets, there is increasing demand for adequate technological support and co-ordination. Few teachers have the skills to provide adequate technological support for the increasing numbers of computers and computer users in their schools. The result is that the emerging teaching and learning infrastructure in many places is often very fragile. An essential aspect of the development of open electronic classes is the coordination of both hardware and software between schools. Without coordinated technology, schools cannot fully participate in electronic networks. However, the purchase of appropriate hardware and software is a matter of confusion for many principals, teachers and School Boards who seek support and advice. Many rural schools with open electronic classes realize that the successful administration of a network requires local technical support. Unless adequate technical support systems can be established, electronic networked classes could be curtailed by teachers who could argue, with justification, that there is insufficient back-up to justify their investment in telelearning. The need to have people in schools, or available to schools, to maintain information technology hardware and software is, for many teachers, a matter of growing importance. In geographically isolated communities the assurance of adequate technical backup is, however, often particularly difficult to provide for teachers and principals. In schools in Newfoundland and Labrador, the majority of which are designated rural, telelearning often depends on the goodwill of one or two teachers with enough knowledge to keep computers going when they mal-function.

Challenge Three: Pedagogy for TeleTeaching

In the changing technological environment, teachers often have a choice of teaching face to face and, for part of a school day, providing or receiving instruction for their students at a distance. This can be done in synchronous or asynchronous mode, with a range of technologies, and with a range of learners. The use of information technologies in schools has been vigorously promoted by the federal agency, Industry Canada (Information Highway Advisory Council, 1995;1997). Students often have more independence in managing their learning in open electronic classes but most have to be assisted by teachers in the setting of goals, the meeting of deadlines and in evaluating their progress (Stevens, 1996). Teachers are effective in open electronic classes if they can be flexible in ways that they allow students to participate in on-line lessons. Strategies and protocols for on-line teaching have to be developed between participating schools if all students are to be able to fully participate. The introduction of a rural school to an open electronic network considerably improves its resource base for both teachers and learners, but does not solve all of its problems. It is often difficult to coordinate the timetables of networked schools and a considerable measure of inter-institutional and intra-institutional cooperation is required to develop detailed and effective plans for collaboration. The need for rural networked schools to have a close relationship with the suppliers of technology has become increasingly apparent to schools, school boards and to technology retailers. Rural schools with telelearning infrastructures require expert advice and support from technology suppliers at the network rather than at the individual school level. There are several immediate pedagogical challenges to be considered for effective teaching in a digital Intranet:

1. Teachers have to learn to teach from one site to another. This is fundamental to the success of teleteaching. Teaching face to face and on-line are different skills.
2. Teachers have to learn to teach collaboratively with colleagues from multiple sites.
3. Teachers have to judge when it is appropriate to teach on-line and when it is appropriate to teach students in traditional face-to-face ways. These judgements have to be defended on the basis of sound pedagogy.

Challenge Four: Professional Development for TeleTeaching

A difficulty many teachers face in Canadian schools is simply finding the time in their busy days to learn about information and communication technologies. It is impossible for some teachers to do this, let alone reflect on how new technologies can be integrated into their classrooms and their professional lives. There is not only a widespread need for professional development for teleteaching; there is a need for it to be provided on a continuous basis. A second challenge facing many teachers is finding effective ways of integrating information and communication technologies, including the Internet, into teaching and learning. It is not difficult to add information and communication technologies to any classroom but it requires considerable planning to integrate technological developments so that both teaching and learning are enhanced. A third challenge for the professional development of teachers is to be able to justify, on the basis of professional judgements, why the Internet and other technologies should be used in teaching and learning at all.

Conclusion

The introduction of inter-school electronic networks has added a new dimension to rural education in Canada and in other developed countries. In Canada and in many other places, teachers and researchers are seeking appropriate ways of using existing as well as emerging technologies to enhance teaching and learning. The teachers and researchers who are collaborating in the development of new electronic structures for delivering education to dispersed, rural sites in Atlantic Canada are very conscious of being pioneers. Both realize there is a lot to learn to about both teaching and learning in this new environment.

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Group interaction as a predictor of learning effectiveness in a computer supported collaborative problem solving

Neli Stoyanova
Faculty of Educational Science and Technology, University of Twente
P.O.Box 217
AE 7500 Enschede, The Netherlands.
stoyanovn@edte.utwente.nl

Abstract: The paper presents an experimental validation of learning effectiveness of three different types of group interaction for computer mediated collaborative learning and problem solving. The assumption underlying this research is that the form in which knowledge is shared in collaborative learning is a substantial for cognitive construction and reconstruction. The experiment revealed that the learning effectiveness is influenced significantly by the mode of group interaction that depends on the extend to which students share their learning not only as results but also as a process of knowledge acquisition and creation by a direct interaction.

Theoretical background and research question

Rapidly changing technologies generate new requirements for creating computer environments that support learning in the broad context of global networking communities. Different theoretical perspectives emphasise collaboration as a successful and powerful activity for learning and problem solving.

Collaboration creates an extension of the internal cognition of the personality in outside world (Perkins, 1993). According Salomon (1993) the individuals' and the shared group cognitions interact with one another in a spiral-like fashion whereby individual inputs, through students' collaborative activities, affect the nature of the joint, shared system, which in turn affects their cognitions. It is emphasised that reconstruction of individual cognition requires a profound and mutual understanding of collaborators' perspectives and shared interpretations of the problem. Only the knowledge that is meaningful for individuals could be internalised.

The assumption underlying this research is that the form in which knowledge is shared in collaborative learning is a substantial for cognitive construction and reconstruction. The main research question is: *Is the mode of group interaction a predictor of learning effectiveness in a computer based collaborative problem solving design?*

Collaborative scenarios

Three scenarios of problem solving group interaction have been designed, based on the assumption that knowledge exists in three forms: as individual mental constructs and precepts, as knowledge in action, and as knowledge embodied in artefacts (Hedlund & Nonaka, 1994)

1. *Distributed interaction.* Group members work autonomously and produce intermediate artefacts embodying their knowledge and visions, which are passed to the other members. This circuit is repeated until all group members reach a common vision of the problem. The process of knowledge acquisition, creation and internalisation is individual.
2. *Moderated interaction.* Interaction process is facilitated by a group moderator (the role is taken by one of the group members) adjusting individually produced artefacts until a common group vision is reached. The representations of individual cognitive structures are not directly accessible but group members are involved in the process of negotiation of meanings and ideas that take place between them and the group moderator.
3. *Shared interaction.* Group members interact directly by synchronous activity and common efforts to solve the problem as a group. They share their knowledge in action. Knowledge is communicated in the process of its acquisition and creation and is not mediated by intermediate artefacts. Collaborative actions of students are the individual inputs toward shared cognition.

Experimental validation

The learning effectiveness of the three modes of group interaction was tested experimentally. The experimental design was a random assignment pre-test post test control group. The independent variable was the mode of group interaction with three levels – "Distributed" "Moderated" and "Shared".

The dependent variable was learning effectiveness operationalised as individual learning achievements in terms of: *fluency* (number of concepts representing individual understanding of the problem), *flexibility* (variety of concepts and ideas), *knowledge acquisition* (number of new concepts acquired), *individual-to-group transfer* (individuals' inputs in the group solution), *group-to-individual transfer* (concepts derived from the group solution), *reconfiguration* (changes in the concepts' structure), *retention* (contra indicated by the reduced concepts), and *creativity* (new concepts and ideas generated individually after the collaboration).

Twenty-six students (6 groups) of University of Twente, Faculty of Educational Science and Technology, enrolled in "Linear and Hypermedia" course, were selected as experimental subjects and were randomly assigned to the three collaborative scenarios. The group task was formulated as an open-ended problem. Concept mapping technique was chosen for representation and communication of knowledge because of its effectiveness as a tool for externalisation and representation of cognition. (Stoyanov & Kommers, 1999). Data was analysed applying one-way ANOVA procedure by SPSS 9.0 statistical package.

Results and Discussion

The results are significantly predictive for the learning effectiveness of the three group interaction scenarios. The mode of group interaction influences significantly the knowledge fluency (Sig. = .047), concepts acquisition (Sig. = .045), and group-to-individual transfer (Sig. = .004). On these criteria students in Shared groups scored significantly higher than students in Moderated and Distributed groups.

All three scenarios enabled students to present and incorporate their knowledge in the group process. No significant difference was found on individual-to-group transfer.

Shared mode was highly beneficial for acquiring knowledge both from each other and from taking new perspectives in exploring the problem space. A significant part of the knowledge that was elaborated in group session were incorporated as a meaningful part of students' cognitive structures and transferred to individual cognitions.

Students working in Moderated mode incorporated less new concepts in their personal cognitive structure than students in Shared mode. Only those aspects of the group solution that were developed by the personal participation of a particular student were internalised in his/her cognition.

Regardless that students in Distributed mode had a broad access to all other students' knowledge representation they were not able to gain enough from the externalised experience of the others.

Both the Shared and Moderated mode proved their potential for reconstruction of the individual cognition represented mainly by reshaping of map spatial configuration. Significant interdependence between common group problem solution and the individual outputs was found. Students working within Distributed mode resist on their prior conceptual structure.

No significant difference was found on criteria of knowledge flexibility. The three types of groups were able to explore the problem space from different perspectives and within different conceptual paradigms.

Surprisingly, the individual creativity was not influenced by the mode of group interaction.

Nevertheless no significant difference was found (Sig. = .345), it should be stated that students working in Shared mode showed a lower level of retention of their initial concepts than the students in the other two modes.

In summary, the experiment revealed that the learning effectiveness is influenced significantly by the mode of group interaction. In general, Shared interaction scenario proved to be the most effective in collaborative learning and problem solving. These leads to the conclusion that the learning effectiveness depends on the extend to which students share their learning not only as results but also as a process of knowledge acquisition and creation by a direct interaction.

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Re-usability problems in large-scale content management of database driven Web based environments

Allard Strijker
University of Twente
P.O. Box 217
7500 AE Enschede
The Netherlands
strijker@edte.utwente.nl

Abstract: Thc use of databases involves assigning resources to users with changing access rights. How will the information be presented to the right users? How can resources be reused for different audiences and how should access rights be provided. Who has the right to change, who can read it and who is owner of the objects in a resource base?

Introduction

The faculty of Educational Science and Technology started a faculty wide implementation of Telelearning with the TeleTop project in 1997. The aim of the project was to support teachers and students with a web based database driven environment. Two years later the entire university, including ten faculties, is ready to the implement the Teletop system. How reuse of material should be provided is a point of research because content management can make the use of objects more efficient.

The problem of assigning resources to people

Scaling up a course management system means that more information will be stored. Reusing includes retrieving stored information. Finding relevant material and assigning this material to the right users is a problem because of the large amount of objects and the large scale of users. A second point of attention is the use of access rights. Access rights are used to give users rights to read or change objects. Using databases includes controlled access to different objects for different users.

Objects:

Every object has users that can read or use the object, users who are able to change or create the object and users that can actual delete an object. These rights are set in the access control list and every database uses some sort of access control list to control access objects in a database. These objects can consist of (elements of) learning material, course descriptions, assignments, multimedia fragments, HTML pages or any other type of digital content. Controlling access to information is needed so that copyrights or confidential material can be stored in a protected environment; i.e. an environment that is not accessible for unauthorized users.

Users:

Users are mostly unaware of these access control lists, because software developers make these environments as easy as possible by not showing objects that users are not authorized to see. The problem in most cases is that objects may be accessible for one user, but not for another. Resources available for teachers may not be accessible for students. Assigning students to these resources may result in irrelevant links for the students. This makes reuse for different users and audiences a difficult issue. This problem has not earlier been identified because most web-based environments are still pilots or prototypes. A faculty wide implementation includes a large number of users who can create objects and even more users that should be able to use these objects. Dealing with a large scale of objects and really reusing these in database driven courses is a new development.

Solution for large numbers of objects

Maintaining access control for every single object in a very large resource base is not manageable. Managing many (more than 10.000) users over many (more than 10.000) objects is a realistic example in our situation at the University of Twente. Combining a number of related objects in a course is a solution to make control access rights manageable. In this way it is possible to assign a set of objects to several predefined user groups comprised of teachers or students. One group can be assigned the role of author and other groups as readers. Copying objects to new courses can involve reuse of objects. This method has been sufficient until now, because in most cases instructors wanted to reuse only the material created by themselves. Reuse as described gives the possibility to make changes to objects for the new audience.

Making objects more flexible

Considering the results of reuse we recently developed a new model for access rights. This model is based on roles that are assigned to user groups. A user group is a list of people who can access the same functionality in a database. So the access control of every object in a course depends on the role a user has. Three roles where identified: Teacher, student and administrator. Using roles makes reuse possible by employing an abstract access level that can be used over courses and provides a consistent control of rights. Objects can be used in every course without changing access control lists of involved courses. The development of a resource browser is in progress. In the first place reuse of objects within a course is being researched, in the second place exchange of objects between courses will be researched.

Challenge, future plans

In the next years reuse of objects at the university level should be supported. Objects should be reused within courses, between courses and faculties. Even different universities should be able to reuse objects in courses. Therefore, interfaces should be developed that support users selecting the right resources. Also, access right models have to be developed. Another objective of our research should be directed at the ownership of objects; i.e. copyrights. Ownership can be seen as part of the access rights involved with objects. Is a user who creates an object the owner and is this user the only one who may reuse or add or edit this object? Who owns such copyrights? All these points need further research. In this respect it is important to note that a number of organizations involving standards for learning technology and related issues are aware of these problems and are trying to find solutions, but until now there is not a standard way to handle large scale resource bases. Examples of these organizations are the Instructional Management Systems project (IMS)[1], the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE)[2], the IEEE 1484P Learning Technology Systems Architecture (LTSA)[3], Advanced Distributed Learning (ADL)[4] and the Aviation Industry CBT Committee (AICC)[5].

[1] IMS: http://www.imsproject.org
[2] ARIADNE: http://ariadne.unil.ch
[3] LTSA: http://www.manta.ieee.org/p1484
[4] ADL: http://www.adlnet.org
[5] AICC: http://www.aicc.org

Computer Support for Unobtrusive Assessment of Conceptual Knowledge as Evidenced in Newsgroup Postings.

Steve Tanimoto*, Adam Carlson*, Earl Hunt*, David Madigan***, Jim Minstrell****

*Department of Computer Science and Engineering, University of Washington
Box 352350, Seattle, WA 98195-2350, USA
**AT&T Research, Shannon Laboratories, 180 Park Avenue Florham Park, NJ 07932-0971, USA
***Talaria, Inc., 705 2nd Avenue, Hoge Bld., Suite 501, Seattle, WA 98104

tanimoto@cs.washington.edu, carlson@cs.washington.edu, ehunt@u.washington.edu,
madigan@yahoo.com, jimminstrell@talariainc.com

Abstract: As the Internet brings new means of presenting information to learners, the need for meaningful assessment increases. We describe the design and development of a computer tool to facilitate a particular form of assessment that can be meaningful in online learning contexts. The tool combines a web browser with an annotation facility, a database, and special means for visualizing assessment data captured with the tool.

Introduction:

As educators explore the many possibilities for delivering instruction online via the Internet, they tend to focus primarily upon delivering presentations of information. The forms of presentation include web pages and web sites, text, images, audio clips, video clips, queries to databases, and Java applets that run simulations. In addition to the information itself, the Internet also enables the online gathering and experience of groups of people who might (or might not) be physically distant from one another. The online communities of learners can be formed such that the members are all at a very similar level of expertise in the subject they are studying. What is largely missing from these innovations, however, is a form of educational assessment that is well adapted to the new patterns of learning.

Assessment is sometimes regarded as the unpleasant part of education, in part because traditional testing is sometimes distasteful to students and because assessment is typically considered less important to the presentation of information. However, studies of assessment in support of learning (rather than in support of administration or of college admission, for example) have lead to recommendations for alternative assessment methods such as performance assessment, authentic assessment, portfolio-based assessment, and continuous assessment (see Tanimoto, 1998). These methods offer the possibility to make assessment a more "natural" part of the learning process, and to permit learning to occur with less stress and in ways more in line with workplace goals. Yet these methods are often difficult to implement because they may require more teacher training, more teachers' time spent on assessment, and because their results may seem to be more subjective than the results of standardized tests. We have developed a software tool for assessment to help us explore one approach to assessing online learning. The tool, called INFACT, permits the assessment to be performed unobtrusively in a manner reminiscent of psychologists' observations from behind the glass wall.

Pedagogical Approach

Our approach to assessment takes place within a particular pedagogical methodology. We have applied the methodology in two subject areas: high-school physics and undergraduate statistics. Students in the class are divided into groups of 4-6 students each. An instructional unit lasts one week. On Monday, a problem that requires conceptual thinking is posed by the teacher. Each student in the class is told to make her/his own interpretation of the problem and suggestion for solving it and to write and post a newsgroup entry using a specially modified version of the HyperNews software from the University of Illinois. The posting is due by 12 noon on Tuesday. This initial post is invisible to other students until a virtual curtain is lifted shortly after noon on Tuesday, at which time it becomes visible to the other members of the student's group. The students are then required to respond to each other's postings in an online discussion, and they are told to come up with a group solution by Friday. Over the course of the week, their postings accumulate, creating an archive which feeds our assessment tool, INFACT.

INFACT stands for "Integrated Networked Facet-Based Assessment Capture Tool." It is used by teachers to view and annotate student newsgroup postings in such a way as to build up a database of assessment information that can be used to track student and group progress in understanding the concepts of the instructional unit. INFACT makes use of catalogs of standard misconceptions that students commonly have about a subject. Each misconception is called a facet, and facets are grouped into clusters such that all facets in a cluster represent misconceptions about the same concept. A facet catalog must be compiled in advance of using INFACT for assessment. However, it is possible to refine a facet catalog in the course of assessment. INFACT makes the assumption that facets can be linearly ordered by their "level of expertise" (see Minstrell 1992 and Hunt and Minstrell 1994 for details).

The Design of INFACT

INFACT comprises the following components: an integrated web browser, a database (currently an MSQL database), dialogs for creating and editing assessment items, and a visualization component. The browser component permits the teacher to load and view HyperNews postings in essentially the same form that the students see when they read and post. This component also supports creating selections of text within the document being viewed. The INFACT software determines (insofar as possible given the limitations of available browser software) the start and end positions within the document where the selection occurs. Selections of this form can then be annotated.

Annotations of two types are permitted: facet annotations and free annotations. A facet annotation represents an atomic assessment item, and it consists of the text selection, a reference to the document in which the text occurs, identification of the student who authored the text, identification of the assessor, reference a particular facet for which this text provides evidence, a certainty value given by the assessor, the date of authoring and the date of assessment. A free annotation is simply a comment associated with the selection. The assessor can check a box associated with each annotation to make it visible to the student. The database is used to keep track of the annotations and to make assessment items retrievable by student, by facet cluster, by date, etc. The database also holds the facet catalog. The visualization portion on INFACT permits the user (usually the teacher) to call up assessment data by student, by group, by date, or by facet cluster. The user can also view graphs that help to reveal trends in the data. Two types of graphs supported by INFACT are (a) histograms of facet frequencies, and (b) facet transition diagrams. The latter show how one or more students' misconceptions about a concept change over time.

As a teacher reads student postings with INFACT and makes annotations, s/he can use INFACT to send feedback to the students. INFACT supports two means of feedback: direct email and student-visible annotations. Direct email permits the teacher to send a message to a student in the context of an assessment item. This can be used to get clarification from the student about something not clear from the posting. It can also be used to commend the student or to make a suggestion. However, its main value over email from ordinary mail programs is the automatic association created between the message and the assessment context in which it originates. INFACT makes it possible for the teacher to include a multiple-choice question in the message that when answered online, provides additional evidence in favor of one facet or another within the facet cluster associated with the assessment item. For a screen shot of INFACT, see http://www.cs.washington.edu/research/metip/crlt/infact-1.gif

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Evaluation of an ITS for the Passive Voice of the English Language Using the CIAO! Framework

Maria Virvou, Victoria Tsiriga, Dimitris Maras
Department of Informatics,
University of Piraeus,
Piraeus 18534, Greece
E-mail: mvirvou @unipi.gr, vtsir@unipi.gr, eagle@ath.fothnet.gr

Introduction

The primary aim of educational software is to help students learn. Therefore, evaluation of this kind of software is crucial. Its aim is to test the functionality and usability of the design and to identify and rectify any problems (Dix et al. 1993). In particular, formative evaluation is one of the most critical steps in the development of learning materials because it helps the designer improve the cost-effectiveness of the software and this increases the likelihood that the final product will achieve its stated goals (Chou 1999). In this paper, we present and discuss the evaluation of an intelligent tutoring system for the passive voice of the English language using the CIAO! framework (Jones et al. 1999).

The Passive Voice Tutor

The tutoring system that we developed and evaluated is called Passive Voice Tutor (Virvou & Maras 1999a; 1999b). The Passive Voice Tutor complies with the architecture of most ITSs, which consists of the domain knowledge, the student modeller, the advice generator and the user interface (Wenger 1987).

In particular, the domain knowledge of the Passive Voice Tutor comprises knowledge about how to convert a sentence from active to passive voice and vice versa. It also provides the knowledge needed for the dynamic construction of new exercise sentences. Finally, it comprises knowledge about the semantic relation between the words used for the construction of new sentences.

The student modeller checks the student's answer and in case of error, it performs error diagnosis. It contains a bug library of the most common student errors and generic mal-rules that students often apply when they have misconceptions. Another responsibility of the student modeller is to keep a history record concerning each student's progress in learning. This record is used in cases were ambiguity arises, so that the system attributes a particular error to a category of errors that the student seems to be prone to.

The advice generator is responsible for responding in the most appropriate way to a student's error, by informing the user about the cause of the error and by showing to him/her the relevant part of the theory. Finally, the user interface of the Passive Voice Tutor, is a multimedia user interface, which involves animations, sounds and a limited form of natural language so that it can attract the student's interest.

The Evaluation

The CIAO! framework outlines three dimensions to evaluate: (i) context; (ii) interactions; and (iii) attitudes and outcomes. One important aspect of context is the reason why CAL is adopted in the first place, i.e. the underlying rationale for its development and use; different rationales require different evaluation approaches. According to the framework, the reason for looking at students' interactions with the software is in order to understand more about their learning processes; such interactions can provide protocol data for later analysis. Finally, at the "outcomes" stage, information from a variety of sources needs to be used including, pre and post-achievement tests, interviews and questionnaires with students and tutors. The overall emphasis of this framework is on educational issues.

There are many other evaluation techniques, such as the JIGSAW model (Squire & Preece 1996) or the 'set of learning with software heuristics' (Squires & Preece 1999), which also address the problem of integrating both usability and learning issues in the evaluation of educational software. In the JIGSAW model, the evaluation is performed in three levels. In Level 1, the subtasks of the learning and operational tasks are considered independently of each other. As we move from Level 1 to Level 2, integration within the learning and the operational tasks is considered. At Level 3 integration between the learning and operational tasks is considered. On the other hand, the set of 'learning with software' heuristics, are an adaptation of the "usability heuristics" presented in Nielsen (1994), so as to relate them to socio-constructivist criteria for learning. These heuristics include the need to consider appropriate levels of learner control, the need for the prevention of peripheral cognitive errors and the need for strategies for the cognitive error recognition, diagnosis and recovery cycle. The CIAO! framework, seemed to be a more suitable method, in the sense that it also evaluated the students' use of the resource package.

For the evaluation along the dimensions of the CIAO! framework, presented above, we have done the following:

i) **Context**: The underlying rationale for the development and use of the Passive Voice Tutor is to help students during the process of learning. Hence, one of the primary aims of the system is to address individual learners' misconceptions and help them correct their errors. Evaluation in terms of the context has been addressed by questionnaires to human tutors before their students had ever used the system. This was done so that the domain knowledge and student modeller could be evaluated. In particular, tutors were given a set of erroneous answers to questions relating to the domain, which were generated using the system's domain knowledge and bug library. For each question, each tutor had to provide an explanation as to what s/he thought the underlying misconception of the error was. Each human tutor's explanation was compared to the Passive Voice Tutor's explanation. A satisfactory degree of compatibility was found (45%). However, the comparisons also showed that the explanations could be improved at a later version of the Passive Voice Tutor.

ii) **Interactions**: On a second phase, tutors were asked to evaluate the system, after their students had interacted with the Passive Voice Tutor. Protocol data was collected through the individual long term user model of each student. This kind of protocol data was first automatically analysed by the student modeller and resulted in information that concerned the student's individual way of learning. Then, human tutors were also given the same set of students' protocols and were asked to analyse them. Finally the tutors' analysis was compared to the system's analysis. To a large extent, human tutors had similar beliefs to the system's beliefs about the students who took part in this evaluation stage.

iii) **Attitudes and Outcomes**: In the case of the Passive Voice Tutor, at the outcomes stage, questionnaires were given to students and tutors. Students' questions included the following: "Did you consider the system responses to your errors helpful for understanding your mistakes?" Tutors were also asked to evaluate the outcome of the use of the system, after their students had interacted with the Passive Voice Tutor. Therefore, the teachers were asked to provide information about whether the software helped them to understand better the difficulties that their students had in learning the passive voice of the English language. Tutors also seemed quite satisfied by the system's student modelling component. Finally, the progress statistics of each student that had been recorded in his/her long term student model was also used at this stage of the evaluation. The analysis of this kind of data showed that the majority of students (57%) made a progress in their learning, whereas only 43% did not seem to have any progress in their learning of the passive voice. This is an encouraging result in terms of the educational effectiveness of the system.

Conclusions

The CIAO! framework for evaluating educational software has provided insight for several aspects of the software that needed evaluation at several stages; e.g. before any student had interacted with the software and after. In this way, both learning effects and usability issues could be evaluated. The results of the evaluation showed that the Passive Voice Tutor was quite satisfactory but there is scope for improvement in terms of the explanations provided by the system.

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Using A Speech-Driven, Anthropomorphic Agent in the Interface of a WWW Educational Application

Maria Virvou, Nikitas Sgouros, Maria Moundridou, Dimitrios Manargias
Department of Informatics, University of Piraeus,
80, Karaoli and Dimitriou St., Piraeus 185 34, Greece
mvirvou@unipi.gr, sgouros@unipi.gr, mariam@unipi.gr

Introduction

Web-based education has the obvious benefit of allowing platform independent access to easily updated teaching material. Recently, a large number of educational applications have been delivered through the World Wide Web. Unfortunately, most of these systems are static, they do not maintain a student model and thus they are unable to provide individualised tutoring. Nonetheless, the future of web-based education seems promising since researchers in the field of Intelligent Tutoring Systems have made quite successful attempts to either move existing ITSs to the WWW or build from scratch web-based ITSs (Eliot et al., 1997; Stern et al., 1997). However, the development of an ITS requires the involvement of a large number of people, including experts of the specific domain, instructors and programmers. A way to overcome these problems may be the development of authoring tools, which will help construct cost-effective and reusable ITSs in various domains. One such authoring tool for ITSs is WEAR (WEb-based authoring tool for Algebra Related domains). WEAR incorporates knowledge about the construction of exercises and a mechanism for student error diagnosis that is applicable to many domains that can be "described" by algebraic equations (Virvou & Moundridou, 1999).

WEAR uses a talking head in its interface with the students. Animated characters have often been used in the interfaces of systems (Rist et al., 1997; Stone & Lester, 1996). Such an interface makes a system more appealing and attractive to the user and if talking about an educational application it may also promote the learning objectives. Walker et al. (1994) investigated subjects' responses to a synthesised talking head displayed on a computer screen in the context of a questionnaire study. Their findings showed that compared to subjects who answered questions presented via text display on a screen, subjects who answered the same questions spoken by a talking head spent more time, made fewer mistakes, and wrote more comments. In this paper we describe how the talking head is used in the whole educational application.

Description of the System and its Interface

WEAR aims to be useful to teachers and students of domains that make use of algebraic equations. Such domains could be chemistry, economics, physics etc. In particular the tool accepts input from a human instructor about a specific equation-related domain (e.g. physics). This input consists of knowledge about variables, units of measure, formulae and their relation. When the human instructor wishes to create exercises s/he is guided by the system through a step by step procedure. At each step of this procedure the instructor specifies values for some parameters needed to construct an exercise. Such parameters could be for example what is given and what is asked in the exercise to be constructed. After the completion of this procedure the tool constructs the full problem text and provides consistency checks that help the instructor verify its completeness and correctness.

WEAR assigns to each student a level of knowledge according to his/her past performance in solving problems with the tool. The tool suggests each student to try the problems corresponding to his/her level of knowledge. When a student attempts to solve an exercise the system provides an environment where the student gives the solution step by step. The system compares the student's solution to its own. The system's solution is generated by the domain knowledge about algebraic equations and about the specific domain in which the exercise belongs (e.g. economics). While the student is in the process of solving the exercise the system monitors his/her actions. If the student makes a mistake, the diagnostic component of the system will attempt to diagnose the cause of it.

When interacting with the students WEAR responds through a talking head, representing in some cases the instructor and in some others a co-student. The talking head component of the system uses speech synthesis to automatically produce speech output from text using MBROLA, a freely available speech synthesiser (http://tcts.fpms.ac.be/synthesis/mbrola.html). The talking head renders the interface quite attractive to students through the sound of speech. Moreover, since WEAR is an authoring tool for ITSs there are a lot messages that are dynamically formed during the execution of the application. Therefore, the authoring tool could not use pre-stored material for the speech feature but rather a speech synthesiser.

In the case when the talking head represents the instructor it guides the student to the environment, recommends what problem to solve next and reads the problem text from the database of the authoring tool. Since WEAR is an authoring tool, new exercises are continuously added to its database. When the student begins to solve the problem, s/he may choose to solve it either with a simulated "co-student" or with the "instructor". These two different choices are only on the level of the user interface. This means that they use the same underlying reasoning abilities from the diagnostic component of WEAR.

If the student selects the mode of the "co-student" then the talking head provides very friendly messages as a peer to the student. This simulated student is responsible for providing positive feedback when the student's actions are correct and for pointing out the student's underlying misconception in case of an erroneous action. The information concerning which actions are considered correct or not and also the messages that the simulated student should say are provided by the diagnostic component of WEAR. The talking head as a simulated student is aimed at increasing the student's attention and possibly collaboration attitude (although in a limited form). Indeed as VanLehn et al. (1994) have pointed out peer learning even in a setting where the other peer is a simulated student may increase students' collaboration skills.

If the student selects the mode of the "instructor" then the talking head provides messages similar to the "co-student" but they are more formal and the diagnosis of misconceptions goes one step further to resolve ambiguities using the long term student model. Indeed, there may be cases where a student's erroneous action may be attributed to more than one misconception. In such cases, the diagnostic component first consults the long term student model and then through the talking face asks the student a question to determine his/her underlying misconception and resolve the ambiguity. The benefit of directly asking the student is twofold: firstly, the system may find out the real reason for the erroneous action and provide appropriate feedback and secondly, the student through explaining why s/he acted in that way gains more knowledge and understanding. It is a common finding in many researches that explaining things either to oneself or to another student helps one's understanding (Webb, 1989; Pressley et al., 1992).

Conclusions

In this paper we described the work in progress of the development of a web-based authoring tool for Intelligent Tutoring Systems. The tool, called WEAR, aims to be used by teachers and students working in domains that make use of algebraic equations. In this paper we focussed on the interface of the ITSs that are generated by WEAR: animated talking heads are used to simulate both the instructor and a co-learner of the student solving a problem. In that way, instruction and feedback are more "human-like" resulting in friendlier and more appealing ITSs. Furthermore, the students interacting with WEAR, may gain better understanding of the domain being taught and also improve their ability to collaborate with others; benefits that arise from the peer learning situation in which the students are involved.

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A Domain-Independent Reasoning Mechanism for an ITS Authoring Tool

Maria Virvou
Department of Informatics, University of Piraeus,
80, Karaoli and Dimitriou St., Piraeus 185 34, Greece
mvirvou@unipi.gr

Introduction

Intelligent Tutoring Systems have traditionally been very good at providing dynamic aspects to the educational system's reasoning. This is usually due to the student modelling component that attempts to follow the student's way of learning taking into account possible misconceptions that the student may have. Other important dynamic features of ITSs are due to the advice generator that models the tutoring strategy by which the student is going to be taught the domain.

However, ITSs have often been criticised that they represent immensely complex approaches to building learning environments (Boyle, 1997). A solution to this problem may be authoring tools that provide the facility of building multiple ITSs. In particular, as Murray (1999) points out ITS authoring tools may give the instructional designer a combination of facilities to produce visually appealing, interactive screens and a deep representation of content and pedagogy.

This paper describes an authoring tool for ITSs that incorporates a domain-independent reasoning mechanism. The reasoning mechanism is used for the student modelling and the tutoring strategy of the resulting ITS.

Related Work

The domain-independent reasoning mechanism of the authoring tool described in this paper, is based on an adaptation of a cognitive theory called Human Plausible Reasoning (Collins & Michalski, 1989). Human Plausible Reasoning theory (henceforth referred to as HPR) is a domain-independent theory originally based on a corpus of people's answers to everyday questions. HPR formalises the plausible inferences based on similarities, dissimilarities, generalisations and specialisations that people often use to make plausible guesses about matters that they only know partially. These inferences may lead to either correct or incorrect guesses; in any case these guesses are plausible.

This theory can be used as a domain-independent generator of plausible human errors or as a way of reasoning for open questions. Indeed in previous research we adapted and used HPR in the user modelling component of an intelligent help system for UNIX users (Virvou, 1998; Virvou & DuBoulay, 1999) and in an intelligent learning environment for novice users of a GUI (Virvou & Stavrianou, 1999; Virvou & Kabassi, 2000). In the present research we adapted and used HPR for the student modelling of multiple domains, such as geography, biology etc. and as a tutoring strategy for teaching students how to deal plausibly with open questions. In addition we have provided the facility to human instructors to construct the knowledge - base of the domain to be taught to students.

Operation of the Authoring Tool

The initial input to the authoring tool is a description of factual knowledge of a specific domain given by a human teacher. Then the tool constructs a knowledge base concerning the specific domain in the form of hierarchies, which is compatible with HPR. The human teacher may also construct tests that consist of questions concerning the factual knowledge of the domain.

The resulting ITS may be used by students who can be shown facts from the knowledge base. In addition students may test their knowledge by answering the questions that the human teacher has given. The student modelling component examines the correctness of each student's knowledge and the soundness of the reasoning s/he has used. Information about each student is kept in a long term student model. This kind of information may be used to measure the student's progress and record persistent misconceptions and weaknesses of the particular student.

The tutoring component of the resulting ITS poses questions to the student who is asked to give an answer and an explanation for this answer. For example, in the domain of geography the tutor may pose the question: "Does Italy produce lemons?" Then the student may answer either "Yes" or "No" and give an explanation for his/her answer. An explanation could be "Yes, because I know it does". If the student does not possess the factual knowledge needed for this answer s/he may say: "My guess is yes. I know Spain produces lemons; Spain is similar to Italy in terms of agricultural products. Therefore, Italy probably produces lemons". In this case, both the answer and the reasoning are examined by the ITS. There may be cases where the student's answer may be incorrect but the reasoning reveals that the student has a good knowledge of geography and uses it in a plausible way.

In particular, there may be several cases of combinations in terms of the correctness of the guessed answer and the correctness of the reasoning. One case is both the guessed answer and the reasoning used to be correct. Another case is the guessed answer to be wrong but the reasoning used to be correct. In this case the tutor informs the student about the mistake but admits that the reasoning that the student used was plausible. A third case is the guessed answer to be correct but the reasoning used to be incorrect. In this case the tutor informs the student that the answer was correct by chance. There are also cases where the reasoning used may be correct but the factual knowledge of relevant topics may be incorrect. For example, if the student was asked whether Italy produced coffee and answered "My guess is yes because Spain produces coffee and Spain is similar to Italy in agricultural products". In this example Spain is similar to Italy but it does not produce coffee.

The learning environments that result from this authoring tool are more open than tutoring systems which do not have any reasoning abilities about correct and incorrect knowledge. For example, Ohlsson (1993) suggests the analysis of epistemic activities (arguing, describing, explaining, predicting, etc.) to be more relevant for higher order learning of declarative knowledge than the study of goal-oriented action. In addition, Andriessen & Sandberg (1999) point out that the process of becoming an expert in a certain domain should no longer be solely viewed as the acquisition of a representation of correct knowledge; the knowledge to be acquired should flexibly manage open problems. In this sense the authoring tool provides support in the student's learning of factual knowledge and the reasoning that may manage this knowledge.

Conclusion

In this paper we described the work in progress of an ITS authoring tool that incorporates a domain-independent reasoning mechanism. The reasoning mechanism is based on HPR, which is a cognitive theory about how people make plausible guesses. In this way, the resulting ITSs may provide quite open learning environments for the students to practice their factual knowledge on a certain topic, factual knowledge on possibly relevant topics and the reasoning they use to deal with open problems by combining factual knowledge from relevant topics.

The authoring tool is in the process of being evaluated in the domain of geography and biology.

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EDIT - A Distributed Web-based Learning Network for Distance Education

Lucian Voinea, Gabriel Dima, Ciprian Cudalbu, Marcel Profirescu
EDIL R&D Centre
University "Politehnica" of Bucharest
Romania
lvoinea@edil.pub.ro, gdima@edil.pub.ro, ccudalbu@edil.pub.ro, profires@edil.pub.ro

Ion Miu
IBM Global Services, Education&Training, Bucharest
Romania
miu_ion_jr@ro.ibm.com

Abstract: This paper reports on the results of the project "Open and Distance Learning Network in Information Technology and Microelectronics - EDIT" run by University "Politehnica" of Bucharest, Technical University of Cluj, Technical University "Gh. Asachi" of Iasi, University of Craiova, Romania and IBM Global Services, Education&Training, La Hulpe, Belgium. The paper focuses on the description of the main objectives, technical infrastructure, course materials, impact/target groups, type of learning environment and further developments. A distributed web-based learning environment has been developed within the EDIT project.

Objectives

The main objective of EDIT Project was to develop the first Romanian academic open and distance education network aimed at training the students and academics from the four partners universities. In the long run the network will extend to link the main technical universities in Romania, including researchers and experts from other institutions. The project is financial supported by the Romanian National Higher Education Funding Council for a period of three years.

The project's specific objectives are: 1) to setup and to develop the technical infrastructure; 2) to design and to implement some good examples of education/training course materials in the field of IT and Microelectronics; 3) to deliver the designed courses to our students/customers; 4) to find the best suited learning environments for a given topic/target group; 5) to support itself through contracts with different customers at the end of the three years period.

The Technical Infrastructure

Because of the unique distance learning environment of the Web and the availability in all Romanian universities the EDIT Project focuses on web-based learning environments.

The Design and Implementation of Course Materials

In 1998, EDIT Distance Learning Network starts to deliver his first course on Modeling and Simulation of Semiconductor Processes and Devices (MSSPD) for the MSc students from Department of Electronics and Telecommunications (Drondoe et al. 1998) using an in-house designed web-based learning environment: EDIT Learning Environment - ELE. Presently, we offer four courses for Department of

Electronics and Telecommunications: Electron, Devices and Circuits, MSSPD, Optimization Methodologies and Particle Simulation in Nanostructures (Drondoe et al. 1999).

Impact/Target Groups

The courses are open for undergraduate and graduate students, academics and researchers that can choose between different level of complexity depending on their previous knowledge and personal goals.

The Type of Learning Environment

Depending on the topic and/or target group the chosen learning environment used for implementation of the course material was either ELE and/or two well-known distance learning commercial products (i.e. LOTUS Learning Space and IBM Distance Learning Space/DLS).

The main features of ELE are (see Zolti et al. 1999): www dedicated arhitecture, distributed way of working both in design and exploitation, high degree of reusability, integrated communication system (e-mail and virtual classrooms), web-based publishing system, web-based voting system and secure web access to the database.

Sustainability

The sustainability of the project is envisaged through contracts with online continuing education courses on demand dedicated to enhancement of adults' knowledge/skills and/or to professional reorientation of the unemployed people. A special attention is also given to distance training of the work-force in the corporate sector.

Conclusions and Further Development

A distributed web-based learning network has been presented. At the basis of this implementation lies WWW dedicated architectures. This has allowed us to reach a high level of reusability and also cost-effectiveness. Currently, there is much work in progress to implement more courses within EDIT Distance Learning Network and to further develop the ELE by establishing some efficient authentication methods that would make awarding certificates more legitimate.

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Design Processes Involved in the Creation of Computer Based Learning Environments: Preliminary Results

Steve Wakeham. M.Ed.*
e-mail: swakeh@po-box.mcgill.ca

Robert J. Bracewell, Ph.D.*
email: ed13@musica.mcgill.ca

* Educational & Counselling Psychology, McGill University

This short paper describes dissertation work in progress investigating the cognitive processes and social practices involved in the creation of computer based learning environments (CBLEs). Unfortunately, knowledge regarding the actual design process is very limited. Formal instructional design prescriptions (Dick & Carey 1985; Gagne Briggs & Wager 1988) and design principles based on cognitive psychology (Duffy & Cunningham 1996; Wasson, 1996) do exist but it is not clear how these prescriptions and design principles are used in 'real life'. Research into the cognitive processes involved in instructional design tasks is limited. Studies have examined such things as the extent and nature of alternative designs and stopping rules (Kerr, 1983), expert-novice differences in problem understanding and problem solution (Rowland, 1992) and, expert-novice differences in declarative and procedural knowledge and representations of design (Perez & Emery, 1995). There are very few studies of the design process involved in the creation of CBLEs. The lack of empirical work regarding the design processes and practices involved in the creation of CBLEs is surprising given the important contributions this type of knowledge could bring to future design activities. Studies of the process could indicate where typical difficulties exist and suggest strategies to overcome them. Additionally, it would be interesting to observe the effect of the application of one of design principles on the actual design process.

Theoretical Perspective

The theoretical perspective adopted in this study combines traditional human problem-solving (Newell & Simon, 1972) perspective with an activity theory (Engstrom, 1989) one. Problem-solving research focuses on the internal mental process involved in problem-solving and has been used to investigate instructional design problem-solving process but it has not been used rigorously to study designers of computer material. On the other hand, activity theory investigates how social systems influence human practice. Activity theory has not been used to study the design processes involved in the creation of computer based material but has been used to study other computer design activities. Research that combines human-problem solving and activity perspectives provides a theoretical perspective that recognizes the cognitive and social dimensions of design activities (Bracewell & Witte 1997; Cobb, 1994; Portes 1996).

Questions and Method

(1) What problem-solving processes are involved in developing computer-based learning environments (human-problem solving perspective)

(2) What social practices are involved in the creation of developing computer-based learning environments (activity theory perspective)

A case study of a design team at a local multimedia development firm was conducted over several weeks. Participants included one subject matter expert, an editors and a graphic artists. Data consists of participant observation field notes collected over several weeks, interviews and think-aloud protocols.

Results

Preliminary results indicate that the problem-solving activity of team members is goal directed and involves establishing numerous local plans and frequent evaluations. It is clear that a concurrent analysis that combines problem-solving and activity theory is a very promising approach. It provides data that allows researchers to analyse and interpret the relationship between internal mental processes and social context.

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FM Radio Stations – Broadcasting with the Sun

David Walker
The Commonwealth of Learning
600-1285 West Broadway
Vancouver, British Columbia, Canada
dwalker@col.org

Abstract: This paper describes a case study on the use of community-based low powered FM radio that has been undertaken in Uganda as part of the work of the Commonwealth of Learning. It describes a media solution that employs low-powered FM radio as an effective method of delivering education and information to a rural community. It also describes the inhibitors to proliferation of community radio stations and reflects on the future directions for the use of radio as a delivery system for education.

Introduction

"All available instruments and channels of information, communications, and social action could be used to help convey essential knowledge and inform and educate people on social issues. In addition to the traditional means, libraries, television, radio and other media can be mobilized to realise their potential towards meeting basic education need of all". Final Report World Conference for All: Meeting Basic Learning Needs, Jomtien, Thailand, 1990.

Why Community Radio?

Community radio is an immensely powerful technology for the delivery of education with enormous potential reach globally. Creating opportunities for communities to utilise this delivery system will enable disadvantaged groups to engage in a development agenda, sensitive to their needs and aspirations. In order to serve the underprivileged and rural poor, mass media such as radio must create conditions and mechanisms that provide people with genuine access to useful information. Such mechanisms will offer ways in which people can express their sentiments, opinions, views, dreams and aspirations, their fears and insecurities, their strengths and capabilities, and, of course, their ideas for development.

High illiteracy rates and low levels of schooling among disadvantaged groups, especially women, in many developing countries continues to limit their ability to lift themselves out of poverty. The existing educational system has shown itself to be unable to respond to the massive demand for increased education. This is especially true in many poverty-stricken countries with respect to meeting the massive education needs of the rural poor. Consequently, disadvantaged groups continue to be denied access to information, knowledge, skills and technology transfer.

The answer is to deploy Distance Education techniques and delivery systems such as radio and television based at the community level to address directly local issues and needs.

In order to empower disadvantaged groups as equal partners in development, the limitations of formal and non-formal education are now being challenged. Urgent and new ways to achieve mass education, that can be both efficient and effective, are being sought. In this context, radio, an effective telecommunications medium, was proposed at the Jomtien, Thailand UNESCO Education of All conference in 1990 as one massive solution. Radio can cut across geographic and cultural boundaries. Given its availability, accessibility, cost-effectiveness and power, radio represents a practical and creative medium for facilitating mass education in a rural setting. However ten years on since Jomtien, radio still continues to be an underutilized technology in education. This is especially surprising because from a learner's point of view, radio is user friendly, accessible and a well-established medium. From an educational provider's point of view it is easy to set up, produce and broadcast programmes. After almost hundred years of broadcasting history most nations of the world have more than a respectable level of engineering skills and broadcasting talent to apply the technology in education. In the last ten years, radio has been greatly enhanced by the emergence of new technologies, which have opened up new opportunities for a variety of forms of delivery and access for both broadcaster and listener. For example, portable, low cost FM transmitting stations have been developed and digital radio systems that transmit via satellite and/or cellular are being implemented in many parts of the globe. Internet streaming audio software technology has emerged recently to allow a global audience to listen the news from a distant country. And windup and solar radios have been developed thus freeing radios from expensive power sources. COL is addressing the issue of education for all with creative media solutions that fall under the banner of an initiative called The Commonwealth of Learning Media Empowerment (COLME).

COLME – A Template for a Media Projects

COLME is building creative media models for delivery of information and training in the area of non-formal and formal education.

COLME strives to:

- Provide new skills in the use of technology for the disadvantaged
- Provide media models that will stress local participation and transfer of knowledge and skills
- Provide opportunities for disadvantaged groups to participate and benefit from new technology and media based initiatives
- Create a capacity for dialogue among government sectors, institutions and different interest groups
- Create a research base and body of knowledge that can be utilised by Commonwealth governments, organisation and communities as models for media and technology based initiatives.

Media projects in radio stations and projection, video and audio production, and computing solutions have all been part of the work of COLME in the past several years. The focus here is a portable FM radio station that has been used in several developing countries of the Commonwealth such as Uganda, Namibia and South Africa.

Overview of the Station

Radio is a very powerful technology that can allow large sectors of the population to be reached with information, quickly and economically. Due to national broadcast regulations in many countries, community radio stations have not developed. Also the cost of transmitters, infrastructures, and equipment, has placed most potential community broadcasters at a disadvantage, especially those in the remote rural areas. There is a distinct information gap to the rural corners of some countries resulting from the lack of service by national broadcasters who in some cases have weak or non-existent signal coverage. Under COLME, portable FM radio systems have been tested and implemented as part of media project work over the past three years. The station configuration that was first developed has, with input and data gathered from COLME initiatives in the field, have aided the manufacturer in altering the station to address the each community's need. The station configurations range in price from three for five thousand dollars US including all elements, antenna, transmitter, console, mixer, microphones and CD and tape decks (**Figure 1**). The stations can run from 12 V DC or 120/240 AC.

Figure 1 – Pictured is a station in its watertight carrying case (on the consul starting on the left top the gooseneck microphone, below is the mixer, top right are two tape decks, below are two CD decks). The transmitter and power supply, not pictured, are housed under the consul. The consul is removed from the carrying case when in operation (see Figure 4 for operational mode).

Keys Elements to Success

There are number technological factors that are important in the initial needs analysis before a station can be considered. First the physical landscape must be conducive to an FM signal to reach the intended target audience especially if rebroadcast of the origin station signal is not possible due to cost or licensing regulations. If the landscape is mountainous then there will be difficulty in the signal reaching a large radius of users. Secondly, the station target audience must have radios or access to radios. Thirdly, there must a situation where there is a steady flow of content and a regular broadcast schedule.

Fourthly, the station must be targeted to the local users so that they can directly relate to the content, language, and situations discussed.

In the feasibility stage before station implementation certain conditions must exist to improve the element of sustainability. In-country stakeholders are identified for each of the stations. Their role is to insure infrastructure is in place for FM radio and that all licensing and issues pertaining to community broadcasting are dealt with.

Another important factor is that the broadcasts are in languages that are used daily in the local community level. The national or regional stations do not have the capacity to aim linguistically or at the level of information detail for rural community issues. Community-based stations can be effective if well managed in providing information and training directly to the community. In the case of the COLME installed community station in Uganda, it was imperative that the station be able, by law, to rebroadcast Radio Uganda in the event of important political announcements. Therefore, among the technological upgrades in the design of the station, in addition to the interface for telephone calls, extra microphone inputs for group discussions, and a more powerful transmitter, a facility for radio rebroadcast of the national government station, (in Uganda, Radio Uganda) and international broadcasters (such as the BBC) was implemented.

The overriding factor to the success of these stations has been the proper community access and ownership, which was paramount in the initial project design. If the station is or becomes an integral part of the voice of the community and local interest groups have an equal say in the information that is disseminated via the station, then there is a lesser risk of failure in the long-term sustainability of the station. This can be achieved with good station management that works with community leaders and committees consisting of both political and community leaders.

The local stakeholders, with the aid of COLME, will provide on going evaluation of the stations via listener surveys and media expert evaluation. Workshops will be given in production and survey techniques that will aid broadcasters with improving programming to suit the needs of the community. Local broadcasters will be tapped to train in advanced broadcasting techniques and programme development that will improve community radio personnel.

A Solar Station on the Move – A COLME Case Study

Apac, Uganda is located in the northern region of Uganda. This COLME project was a cooperative effort with the Minister of State and Tourism, The Right Hon. Akaki, to work with community leaders to implement an FM radio station in the Apac region. The COLME feasibility study revealed several limitations with the electrical infrastructure, which was not reliable. This was a result of load sharing throughout the country (Apac would not receive power for several days). The power was also not usable for electronic equipment due to the dramatic power fluctuations. Therefore, it was decided that in order to maintain a reliable broadcasting schedule and develop the station as a center point to community activities by different groups, Radio Apac would be operated entirely by solar power. This would free the project from the constraints of electrical situation and the tariffs associated with it. A configuration was determined, in consultation with a solar distributor in Kampala, to allow the station to stay operational during the eighteen-hour broadcast day. Eight solar panels and seven deep cycle batteries were installed at the station, which now provide lighting and all the station power requirements for daily broadcasting (**see Figures 2 to 4**). The lifespan of solar installations is over a decade with low maintenance costs.

A committee was organized and a station manager appointed. This person works directly with the community to develop programming and allow the development of community involvement. The station has a rebroadcast facility incorporated for programmes from the national broadcaster as well as the BBC and WorldSpace. A further radius of listeners will be taken in Spring 2000 with a retransmission unit that will allow the signal to take in other populated areas. It is anticipated that the total potential listening audience will be over one million. A VHF/UHF radio system will also be implemented to act as a community telephone that will interface into the FM radio system. This will allow the broadcasters to out to the community and speak directly to groups live on air thus eliminating the issue of travel to the station by people such as farmers and medical officers. Links have been made to educational programmers in South Africa to supply educational programmes to the station. The station has been used by the government for health related issues and announcements. There is also an element of income generating by the station with the interest of local businesses in advertising their services.

Figure 2 - Receiving the solar panels at the station site

Figure 3 – Installing the panels

Figure 4 – Radio Apac, 92.9 FM on air, powered by the sun

Conclusion

Radio is an effective system for delivery of education to large numbers of people. It facilitates information exchange at the community level, acting as a "community telephone" and can be effective in literacy and formal/non formal education. Analogue systems for radio will be supplanted by digital broadcasting in the coming decade, however digital radio will pose issues including cost of radio receivers and renewal of broadcasting infrastructure. Analogue radio systems, such as the portable solution that COL and others have utilised in community FM radio initiatives, can be effective in delivering education to the masses without the high infrastructure costs associated with radio broadcasting. With community broadcasting not only can broadcasters focus on addressing local needs through their own produced programming, but also have the choice among a tremendous variety of quality educational content that is available via rebroadcast from national and international sources whether it is delivered via satellite or via the Internet. Rebroadcasting also should be balanced with the needs of the local community and the provision of appropriate and relevant programming content.

There is a marriage between the digital and the FM analogue systems that is taking place. The convergence also includes Internet streamed audio based broadcasters that can effectively be employed by the community FM station in a rebroadcast mode. Will we be able to say in ten years that radio's potential for educational delivery to millions of disadvantaged groups has finally been realised? With the many varied formulas for convergence of digital and analogue technology and the vast selection of content and tools to create original culturally sensitive material for education at the community level, we state clearly - yes. But will the bodies that regulate frequencies for community radio initiatives reform regulations to reflect the current technological developments and pressing need for mass media to meet the goal for education for all in the next ten years? We can only hope. The past ten years and the failure of Jomtien is a heavy burden to bear. The next ten should see the harnessing of radio, analogue, and more so digital, as the powerhouse for delivery of education. Governments should be prepared to adjust broadcasting regulations to adhere to technological developments and realities, and also consider community based mass media delivery as an effective solution for improving a nation's human resource development towards the goal of education for all.

David Walker
Education Specialist (Educational Technology/Media)
The Commonwealth of Learning
1285 West Broadway, Suite 600
Vancouver, British Columbia
Canada, V6H 3X8

Tel: 604 775 8235 Fax: 604 775 8210 WWW: http://www.col.org http://www.col.org/colme
Email: dwalker@col.org

Training Faculty To Use Active and Collaborative Learning And Web-Based Courses In an Integrated Curriculum For The First Two Years Of An Engineering Program Of Study:

John R.Watret, Department of Computing and Mathematics
Watretj@cts.db.erau.edu

David Pedersen, Department of Educational Technology
Pedersd@cts.db.erau.edu

Charles J. Martin, Department of Computing and Mathematics
Martinc@cts.db.erau.edu

Embry-Riddle Aeronautical University
Daytona Beach, Florida 32114-3900

ABSTRACT The authors will describe the programs used in the preparation of faculty who are participating in an Web-based Integrated Curriculum in Engineering (ICE). The programs are a blend of efforts between faculty and the Educational Technology Team.

The ICE program is a comprehensive effort between engineering faculty, humanities faculty, physics and mathematics faculty. The ICE program includes specifically designed sections of the foundation courses required of all engineering students: the calculus sequence, the physics sequence, the humanities sequence, social science, and introductory engineering courses. What differentiates the ICE program from traditional engineering curricula is that all courses incorporate active and collaborative learning and a reliance on computer and web technology. In addition, the ICE program promotes team learning, team design projects, and a well-documented series of assessment practices.

Background of ICE:

The motivation behind this program includes:

- high attrition rates in calculus, physics, and chemistry;
- perceptions of the faculty that these students do not read and write well;
- a lack of comprehension of the building nature of the foundation courses and their relationship to the engineering curriculum;
- the lack of continuous use of common computer technology;
- failure of students to adjust to the university environment,
- and the isolation that many students feel in such programs of study.

The Integrated Curriculum for Engineers was introduced in 1997 to a volunteer group of 65 entering freshmen selected from a pool of 130 initial volunteers. In succeeding years, similar sized classes have volunteered to enter this program.

This paper describes the programs specifically designed by the Educational Technology Team and the programs put together to teach faculty how to use active and cooperative learning in the various courses which are included in ICE.

Description of ICE methodology

Computer and web technology are crucial to the implementation of the ICE program. Students in this program must have laptops for use in each course. Classrooms have been wired so students have access to the campus network and access to the Internet. Common software in use includes Maple, Microsoft Office, Bentley Microstation, and Internet access. All courses are web-based so that students have access to each course in the program, to reference materials, tutorials, reviews for exams, and to each faculty member and to their peers. Forums, emails, chat rooms and links to other sites are all available to every student. Students can plug their laptops into any campus port as well as their dorm room. The authors will discuss examples of daily classroom usage of a web-course and we will comment on the active and collaborative nature of the courses by showing how these are incorporated.

Another crucial component of the ICE program is the use of cooperative and collaborative learning in each course. Thus, in addition to restructuring the content, all courses have been redesigned for an active and collaborative learning environment. Each course assigns team exercises, daily or weekly, which are to be done both in and outside of the classroom. In any of these courses, it is common to ask a team to present their work to their peers at the end of a daily class. In addition, the mathematics faculty designs external team problems that are reported in class about a week later. For each such team problem it is required that the problem be written using a word processor and the report is graded for composition and exposition as well as the mathematics. Class presentations are oral and each team receives a grade based upon accuracy, style and clarity of exposition.

Students in the program are assigned to a team of four. A team is selected based on the class rank condition. A team stays together through all the courses during that semester. The engineering faculty devote the first week of the introductory engineering course to team building skills and continue to monitor the effectiveness of the teams throughout the semester. This engineering course also serves as a student success course based on the University 101 model and include topics such as time management, study skills as well as adjustment and orientation to the university.

Programs of the Educational Technology Team

Most of the faculty who teach at Embry-Riddle use word processing, spreadsheets, and email. A few of the ICE faculty had some acquaintance with use of the web, but none had ever put a course up on the web and many were apprehensive about trying A template was designed specifically for the web-based portion of the ICE program, and faculty members were provided with training on how to develop and post materials in the template.

Because the ICE faculty were technically proficient in specialized areas and working with a web template specific to their program, a customized training program was developed for them by the university Educational Technology Team. A description of the ICE web template and training program and ongoing support for the ICE faculty will be presented in this talk

Programs used to acquaint faculty with Active and Cooperative Learning.

When faculty think of teaching, they think of lecturing - the me- centered model of education. Active learning is participatory - an idea or theme is selected, the students think about it, promote their own understanding, and share it with the class. Collaborative learning is group based - in our case, team-based. It requires the team to work together in and out of class on assignments.

Assessment

Assessment of these training programs include informal and formal components. In this presentation, the authors will comment on each, including what worked and what did not. In addition, we will comment upon some of the measures used by faculty in the ICE program itself. These include attitudinal surveys about use of teams, use of active learning, use of computer technology, use of computer software, use of web-based courses, adjustments to the university, and a variety of other topics. Assessment of use of web-based materials is done by formal assessment at the end of the term. All aspects of assessment will be shared with the audience.

FutureBoard: Supporting Collaborative Learning with Design Activities

Yuhei YAMAUCHI1), Takeshi SUNAGA2), Yumiko NAGAI 2)
Toshiya TAKAHASHI 3), Syunji OGAWA 4) , Isao MATSUI5)

Ibaraki University 1) , Tama Art University 2), Recruit Co.,Ltd 3)
SoftDevice Co.,Ltd 4) , ViewTech Lab Co.,Ltd 5)

yamauchi@mito.ipc.ibaraki.ac.jp 1)

Abstract: The FutureBoard system has been developed to support the collaborative learning process, especially design activities in Project Based Learning.
Two kinds of board system have been created: one is a Personal Board for supporting the personal reflective thinking process based on a wireless note PC, and the other is a Collaboration Board for supporting collaborative learning and the creative process based on a 50 inch monitor with pen input support.

Project Based Learning and Design Activities

In Japan, the national curriculum standards will be changed in 2002, and Project-based learning known as "The period of integrated study" will be introduced to elementary and secondary schools. During the process of project-based learning, design activities such as making books and posters are critical because they give students the chance to reflect on their ideas. Computers have been used for the design activities in project-based learning, however they are limited to student's individual expression when using graphic software and DTP software.
We believe computers can render the process more dynamic when designing activities such as in collaborative design for the social construction of ideas, by many professional designers do.

Design Process of Professional Designers

We have analyzed the design process of professional interface designers (a university professor and two professional designers in a private corporation) in order to clarify points to support the collaborative design process.

1. Using Tracing Paper
All used tracing paper in the collaborative design process. One designer drew an idea on paper, while the other put tracing paper on it, revised and added new ideas to previous ideas.
2. Fast and Interactive Process
This process was fast-paced and interactive. They sketched ideas in a few seconds and talked like a "This is better," pointing the revised idea.
3. Using Personal Spaces
Sometimes, Personal spaces were used such as on a small memo or a corner of the tracing paper to dot down their ideas.

Outline of the FutureBoard System

Following this analysis, we made design policies for the new system that supports the collaborative design process. We named it "FutureBoard".

1. Tracing Paper Function
FutureBoard contains 8 layers of tracing paper wherein the level of transparency can be modified. The lowest layer is called the "Master Layer", a special layer for guiding design activities such as Maps, Axes, Tables, etc.

2. Pen Input and Drawing Tool
A user can employ the pen input (or his/her finger) similar to ordinary paper resulting in the interaction being much quicker. Moreover, the software becomes not just a paint tool but a drawing tool, so that each object drawn can be moved or deleted.

3. Personal Board and Collaboration Board
Two kinds of board system have been developed: one is a Personal Board for supporting the personal reflective thinking process based on a wireless note PC, and the other is a Collaboration Board for supporting collaborative learning and the creative process based on a 50 inch monitor with pen input support.

Personal Board and Collaboration Board

The hardware of the Collaboration Board system (CB) consists of a PC and a 50 inch projection monitor with pen input support and a wireless LAN station.

The software of CB is a simple drawing programme with 7 half transparent layers. The user can control the visible/invisible aspects of the specific layers as well as control the 5 levels of transparency. All operations are assigned to the icons, thereby eliminating the menu bar.

The hardware of the Personal Board (PB) system consists of a pen-based PC and a wireless LAN card.

The software of PB is a subset of the Collaboration Board that has two layers and is optimized for SVGA screen. (The CB is of XGA size)

Initially, students will use the PB, and then send the work to the CB's layer. With the CB, they can lay ideas on the other half of the transparent layers. And CB's data can be downloaded to a PB using the wireless LAN system.

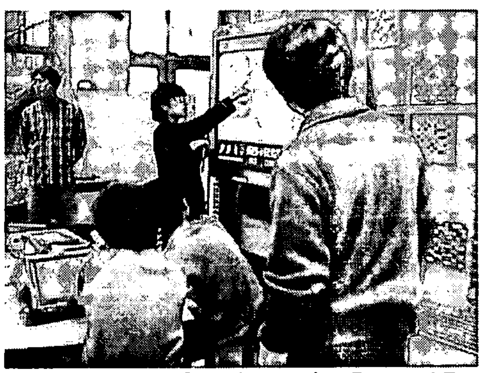

FIGURE 1: Jr.HS students using Personal Board and Collaboration Board

Evaluation

The FutureBoard system was evaluated from November to December of 1999 at Utase Junior High School in Chiba Prefecture, JAPAN. The system was used in project-based learning about "Makuhari Bay Town" where the students live. To meet the goals of the curriculum, Small groups were formed. The students explored and researched many aspects of their town, such as the traffic system and road safety, the soundscape of the town. They reported the result of their research on the Personal Board and transferred the data to the Collaboration Board. Using Collaboration board, They discovered new ideas from the overlapped information and made final presentations to an audience composed of classmates, teachers, municipal officials and parents.

We are now evaluating how these tools supported the collaborative process by protocol analysis and interviewing. The main points of the evaluation center around how 8 half-transparent layers and drawing tools work as a cognitive resource in collaborative process.

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Merging Physical Manipulatives and Digital Interface in Educational Software

Anna Zacchi, Nancy Amato
Dept. of Computer Science
Texas A&M University
USA
{zacchia, amato}@cs.tamu.edu

Abstract: In this paper we describe how elementary school students used physical manipulatives in conjunction with the digital interface of educational software for geometry. The blending of physical manipulatives and digital interface may help them to overcome the limits of the representation and interaction modalities of the digital interface.

Introduction

Our study used SuperTangrams (Sedighian & Westrom 1997), a program developed by the EGEMS group at the University of British Columbia. We introduced manipulatives that students could use while playing with the software. The idea was to use manipulatives in conjunction with the software in order to overcome the representational problems of the interface. Manipulatives allow the students to experience what they are doing on the screen in the real world.

SuperTangrams. SuperTangrams is a computer-based learning environment for two-dimensional transformational geometry. Learning of this mathematical domain is situated in the context of the traditional tangram puzzles game activity. The player is challenged to put together several geometric shapes to fill a given outline. To move the shapes on the screen the student selects and applies to them one of three transformations: translation, rotation, and reflection.

Subjects and Settings. The study involved approximately 180 fifth grade students at a College Station, Texas, elementary school. The task of each student was to play with SuperTangrams to solve the tangram puzzles. The student was free to use the tools that we placed on the side of his computer. Data collection techniques included class observations, video-recordings, scratch paper used, pre-tests and post-tests, questionnaires and log files of computer sessions.

Use of Physical Manipulatives

First set of manipulatives

During a first study session (two weeks), we provided the students with the following manipulatives:
1) a set of tangram plastic shapes, 2) a reflection mirror, 3) a colored grid board with a rotating stick.
The board had two different drawings on it: a line for reflection and a circle divided in 16 sectors of equal size. This is consistent with the software that allows the minimal angle to be $1/16^{th}$ of a circle. A stick is connected to a hub at the center of the circle and can rotate 360°. The idea was that the students would place a shape on the circle and then rotate it by pushing against it with the stick. We intended for them to use the reflection mirror with the line drawn on the grid board to find the reflection line.

Rotation. One common use of the shapes was to put them on the screen and animate them. A video recording shows a girl using them for rotation. She started superimposing one plastic shape on the digital shape on the screen, and then she moved the shape along the arc of rotation trying to move and rotate it at the same time. In this operation she paid attention to the position of the shape on the screen, but not to the orientation, or angle of rotation. The students who used the grid positioned the plastic shape on the circular drawing, trying to position the shape in the same orientation as the one on the screen. Then they would push the shape with the stick until the shape could reach the orientation of the target. They would count the number of sectors the stick moved and move the digital handle accordingly. Some students felt comfortable with the board, while some others preferred to bring the shapes directly to the screen.

Reflection. Students did not use the mirror on the grid board with the plastic shapes as we had expected. Instead, they placed the mirror directly on the screen and looked for the reflected image of the digital shape. The first operation involved was to position the mirror until they could see the reflected image superimposed on the target. Once the position was found, they had to play with the digital handles to position the reflection line along the position found for the mirror.

New Manipulatives

The use the students made of the manipulatives surprised us, since they preferred to use them on the screen, merging the physical operations with the digital ones. Thus, for the second session, with a second group of students, we modified the manipulatives to make it easier for the students to use them on the screen. We eliminated the grid board and built a rotation tool consisting of two popsicle sticks joined together at one end in such a way that they could rotate, and placed some sticky paste on the other ends. The popsicle stick had more success than the grid. The students would stick the chosen shape at the end of one stick, and position the two overlying sticks directly on the digital radius of rotation, with the plastic shape matching the digital shape. Then they would rotate the stick holding the shape and keep the empty stick in the initial position. When the plastic shape reached the target, the opening of the two popsicle sticks represented the sought after angle. In this case they could hold the right "angle" in their hand. Finally, they would recreate the digital angle playing with handles, holding the physical one as a model.

Student reactions

The second set of tools had more success than the first. It was more natural for the children to bring the tools to the screen, and they could physically experiment with the transformations. In the questionnaires we asked children if it was good to have manipulatives, and if they helped them learn. Here are some of the answers:

> *"They helped because they were 3D;" "they helped you to learn the movement;" "all tools because they helped you think ahead;" "you need some reference to look at;" "because it is important to have stuff you can work with in your hand;" "it helps understand."*

Conclusions And Future Work

Software running on a computer is something abstract: when the student drags a handle with the mouse something happens on the screen. In educational software for geometry it is important that the student learns to relate what happens on the screen to the real word. Our preliminary findings indicate that physical manipulatives can be a valuable addition to educational software. We noticed how the use of manipulatives helped students overcome limits of the representation and of the types of interaction allowed by the interface. For example, additional information on the screen whose purpose was to help the students, such as additional lines, actually confused them, causing them to miss important concepts. Using a physical representation of those concepts, such as an angle between two popsicle sticks joined together, helped them to focus on the main aspects of the transformation without being lost in representation details. During our study we collected log files and data relative to pre-test and post-test. The statistical analysis of this data will determine the effect on learning of the different tools.

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CORPORATE DEMO PAPERS

Public broadcasting archives and documents used for educational purposes

Pierre C. Bélanger
Société Radio-Canada
1400, boul. René-Lévesque Est, 8e étage
Montréal (Québec), H2L 2M2
pierre_c_belanger@radio-canada.ca

Carole Poirier
Société Radio-Canada
1400, boul. René-Lévesque Est, 8e étage
Montréal (Québec), H2L 2M2
carole_poirier@radio-canada.ca

Contemporary education needs to be connected to the very world it purports to study. In this context, media archives and documents are value-added material that can support both traditional pedagogical practices and media literacy related activities. Public broadcasting archives and related documents can play an edifying role in offering various sources through which to grasp a host of current and historical issues. Recognizing the educational value of its media assets, Radio-Canada is working with schools, colleges, and universities in exploring a variety of pedagogical scenarios in which media content can complement traditional study material. This presentation will illustrate how Canada's public broadcaster can, by means of forging partnerships with various organizations (multimedia, cultural, or educational), and repurposing of media archives, play an active role in the development of educational Web content as part of a constructionist approach to learning.

Learning Code

Suzanne Rhodes, Human Code, USA

Who We Are

The Learning CodeTM development team extends beyond the walls of our studios to include the clients we work with and the learners we work for as well as a passionate and compassionate team of education specialists which includes the following professionals:

- Educators
- Interaction Specialists
- Producers
- Artists
- Technologists

What We Do

At Human Code, our mission is to humanize technology to fundamentally transform the way people learn, work and play. Human Code's Learning Technology Group meets this challenge by designing spectacular learning environments.

Our approach affords the Learning Technology Group with the discipline to manage the complexity of tasks that characterize each design stage, as well as the flexibility to provide appropriate consideration to the six interrelated components that define each of our spectacular learning environments. These components include:

- Setting
- Community
- Content
- Pedagogy
- Tools and Technologies
- Assessment

How We Do It

Derived from years of best practices and research in the field of learning technologies, our Learning CodeTM approach to educational environment design is an iterative process that motivates our team of specialists through the following comprehensive design stages:

- Envision
- Design
- Produce
- Implement
- Integrated, On-going Reflection

Who Benefits?

Targeted learners

Learning Code TM engages the learner in an experience that is personal, relevant and meaningful. Our environments engender a love of learning, content mastery, higher-order thinking, and inspire life-long learning.

Clients and Educational Partners

Learning Code's collaborative nature transforms clients into development associates. Skillfully managed projects, delivered on-time and on-budget meet the needs, goals, and expectations of our client partners.

Human Code

Each project affords our company teams with heightened knowledge, skills, and abilities that inform future designs and techniques. The result is continually evolving processes, products, and services.

About Human Code

Human Code is a leading developer of interactive experiences for e-commerce, games, learning systems and marketing communications. The company's approach combines creativity, consulting and technology to create user-centered solutions that change the way people learn, work and play. Human Code's creativity and client-service focus are maintained through the company's Studio Network, which includes Austin Studios, Presage Studios in San Rafael, CA, Human Code Japan in Tokyo, and Human Code Shanghai. The company was founded by industrial designers in Austin, Texas in 1993, and received venture investments from Austin Ventures and Applied Technology in 1995 and 1999. Additional information on Human Code can be found at www.humancode.com.

Human Code's Learning Technologies Group is emerging as a market leader in creating spectacular learning environments. From a statewide initiative in Idaho to programs that provide entry-level technology workers with training in hard and soft skills, Human Code is becoming known as a true total solutions provider for educational technologies.

Teaching and learning in a virtual campus: The model of the Universitat Oberta de Catalunya

Albert Sangrà
e-Education Laboratory
Universitat Oberta de Catalunya
asangra@campus.uoc.es

Lourdes Guardia
Head of Instructional Design Unit
Universitat Oberta de Catalunya
lguardia@campus.uoc.es

By combining the latest technologies with both a solid pedagogical foundation and continuous evaluation, the Universitat Oberta de Catalunya has built a Virtual Campus: an electronic communications environment that provides the means to effectively support the tutoring of students, and the provision of university resources and social activities.

It has presently a total of 13.000 registered students. Eight main degree programs are offered, as well as Master programs, postgraduate courses and a wide offer of continuous education programs.

The organization is also working on the *Metacampus*, which mission is to demonstrate the global, virtual co-operation of universities; a concept known as the flexible university which is achieved by interconnecting the partners virtual services and infrastructures.

It will be able to capture, register, invoice, teach, assess and accredit courses and provide all the administrative services in a global scale, using the Internet as the only medium to support all these educational processes.

Deploying Web-Based Assessments

Eric Shepherd

Learn the principles of creating and administering Web-based tests and assessments using Question Mark™ Perception™ software. Find out how to use Perception's authoring wizard to create questions in a variety of formats: multiple choice, multiple response, hot spot, text, numeric, selection, and matrix questions as well as explanation screens that can include text, graphics, and multimedia. Participants will also learn how to create multiple question banks from which to assemble tests, surveys, and questionnaires. Other topics include how to set up interactive feedback, create adaptive tests, analyze test results, and create reports. . Example questions will be presented from various applications including competency testing, employee recruitment, customer satisfaction questionnaires, study aids, diagnostic tests, skills assessments, product knowledge exams, course evaluations, and certifications. The presentation will cover such issues as test security, linking with learning management systems, and the use of Perception Secure Browser for high-stakes tests.

CORPORATE SHOWCASE PAPERS

The LearningStation.com

The LearningStation.com is dedicated to providing a realistic and cost-effective way to manage technology and make it available to the teachers, students, and administrators who will transform the educational process to meet the expectations of the information economy.

The LearningStation.com is the leading and largest Application Service Provider (ASP) and portal in the educational market, providing online access to educational content, tools, and applications, on a subscription basis. With The LearningStation.com, a managed and maintained library of applications is made available to PCs, Macintosh systems, and thin-client devices across the school's network and over the Internet. The LearningStation.com Chief of Innovation and Co-Founder Jim Pennington states, *"Schools are extremely excited to hear that they can get out of the software management business, and focus on using software rather than delivering it," says Pennington, "and the fact that they can make good use of their installed base of cross-platform computers has a significant impact on their ability to make technology accessible to more students and teachers."*

The Education Market Opportunity

Technology is now accepted as an integral part of education in Canada. As awareness of the importance of preparing students for the information age grows, school boards are turning an increasing amount of attention to this process. Educational spending now accounts for 8% of Canada's budget, and technology is fast becoming a priority, including significant investment in hardware, software, and cabling. In the 1997 - 1998 school year, $230 million was invested in bringing computer technology into Canadian classrooms.

Despite a high level of spending, most schools are equipped with a collection of computers ranging from Apple II to x386 to Pentium-based computers. This presents an implementation nightmare. It is currently impossible for schools to incorporate new software applications into their curriculum without consistently upgrading their hardware, a situation which is neither desirable nor cost-efficient. Regular overhauls of computer equipment is financially impossible for schools with limited budgets. This issue is probably the single largest barrier to institutional technology integration.

The Learningstation.com presents a solution to this problem. It has the potential to completely reorganize instructional computing as we know it. It would allow schools to run brand new applications, as well as provide web access and e-mail, while removing the financial burden of having to constantly upgrade hardware. It would also allow schools to use equipment donated through programs such as the Computers for Schools Program, which provides schools with recycled business and government computers.

What is thin-client computing?

Citrix Systems, the world leader in server-based computing, reports over 2,000,000 ports in place supporting over 10,000,000 users today. The idea behind the thin client is simple: concentrate computing power, storage, applications, and data on "servers" (powerful computers) and provide users with a simple "client" computer that is easy to install and maintenance-free. Users connect to The LearningStation.com servers over the Internet to process applications, access files, print, and perform all other services available to ordinary computers. Since the applications and data are kept on a server, only keystrokes, mouse clicks and screen updates travel the network, so just a fraction of the normal bandwidth is required to run applications. Thin-client delivery has the flexibility to support any device—from full-featured computers like PCs, Macintosh systems, and UNIX workstations, to Windows-based terminals and hand-held information appliances.

How do schools benefit from using an Application Service Provider (ASP)?

- **Reliability and Ease of Use**

ASPs allows teachers and students to spend more time working on technology projects such as accessing information on the Internet and using educational software—rather than spending class time fixing and upgrading PCs or adjusting software programs to suit each individual workstation. Users simply log on and access their applications and data.

- **Simplified, Centralized Management**

The LearningStation.com's servers are managed by skilled network administrators, removing this responsibility from educators. Updates and additions are made only once at the server and are immediately available to all users.

- **Lower Cost of Technology**

Zona Research, a technology research firm, estimates that organizations will save 54-57% of their systems administration costs over a period of 5 years with a thin-client computing approach. Using the services of an ASP further reduces costs by eliminating software upgrades and inefficient purchasing volumes.

- **Security**

Vital data and applications may be kept on The LearningStation.com servers creating a higher level of security. Sensitive applications and data are made available to authorized users only via password protection. Data is effectively secured and backed-up in one central location either on a local customer server or at The LearningStation.com.

- **Universal Access**

Since applications and data are stored on the server, access is available to students and faculty from any machine at any location and at any time via an Internet connection and the desktop appearance is always consistent.

Strategic Alliances

The LearningStation.com has created a network of strategic partners supporting thin-client delivery of applications to the education market. The LearningStation.com is continually looking for new strategic partners to enhance it's offering to education customers.

Software Publishers and Online Content—The LearningStation.com has strategic agreements to offer products from:

- Microsoft
- The Learning Company
- Sunburst Communications
- Saratoga Group
- Infonautics
- Schepp-Turner Productions
- CBT Training
- Lotus
- Learning Outfitters
- Steck Vaughn
- MediaSeek
- Webivore
- Fog Cutter
- SkillsBank
- And many others

Technology Partners—The LearningStation.com has strategic agreements with:

- Citrix
- Sun Microsystems
- Empower Corporation
- MCNC
- Wyse Technology
- Computer Network Power
- Boundless Technologies
- Boca Research
- OZ New Media

Server Access Accounts

The LearningStation.com customers use Server Access Accounts (SAA) that allow access to the LearningStation.com server farm via the Internet. Users have access to a basic package of applications and services that include:

- Reference.Center, a customized version of Infonautic's Electronic Library
- Adventure Online, real world-based core learning materials
- Star Office Suite, an online suite of productivity tools
- Facilitator, conferencing tools for collaborative learning
- Internet filtering and virus protection utilities

Additional products and services can be added as desired including:

- Microsoft Office or Works
- SkillsBank or Cornerstone basic skills software
- Classroom Planner, a comprehensive teacher productivity tool
- Webivore, a directory of educationally reviewed web content
- Explorasource, a curriculum correlation tool for teachers.
- Many, many more

Schools require a Local Area Network (LAN) to provide users access to The LearningStation.com. A T-1 line, or a fast broadband connection like high speed cable modems, is recommended for school site access, while an individual account can gain access over a modem. SAA's are for concurrent usage, so schools only need to purchase as many accounts as they will use at one time. Access is 24 hours a day, seven days a week, allowing teachers, students and parents to gain access from home and after hours as well.

Total Cost of Ownership

Typically, educational technology purchase decisions are made on the basis of acquisition cost and compatibility. As technology usage becomes more pervasive, educators will need to pay more attention to the Total Cost of Ownership (TCO) which includes support and maintenance costs, reliability, and lifecycle replacement costs. And in these areas, thin clients continue to out perform new PCs in cost effectiveness by a wide margin.

Zona Research, a technology research firm, estimates that organizations will save 54-57% of their systems administration costs over a period of 5 years with a thin-client computing approach. And this cost savings is in addition to the lower cost thin-client devices and ability to leverage your current computing infrastructure—hardware, applications, networks and training—to extend the reach of your thin-client network.

A study by the Gartner Group released in June 1999 estimated that thin-client applications require 80 percent less management than traditional PC deployment (Computer Reseller News Online, 6/1/99).

Here are some details of the Gartner Group Study for annual PC cost of ownership:

- Actual cost of the PC Three-year depreciation $677
- Non-Labor Expenses Software, network connectivity, etc. $1677
- Technical Support Service, Maintenance, Help desk $1089
- Network Capital Cabling, Servers, etc. $585
- Network Support Management, virus control, etc. $544
- End User Admin Backups, upgrades, productivity loss $981 from downtime, etc.

Total Cost of Ownership $6507

Thin-Client Computing Cost Savings

While schools typically cannot provide the type of support that is described above, the information serves to illustrate the cost savings that thin client computing provides. In fact, the lack of resources available to support PCs makes an even stronger case for thin-client devices in education. The cost savings of thin-client computing in education are just starting to be quantified:

- Thin client devices can have an effective life of 5 - 10 years
- Your current PC's can be easily utilized as Thin client devices
- Software is a fixed annual expense without hidden version upgrade expenses
- Network support can be provided centrally on servers instead of desktops
- End users have a common, easy-to-learn desktop environment
- Downtime loss from viruses, hardware failures and vandalism are all but eliminated
- Universal access enhances productivity and leverages the technology to more users

SPECIAL INTEREST GROUPS

Campus Notebook Computer Programmes

Craig Blurton, University of Hong Kong, China

Notebook computer programmes are proliferating as many universities move from "corporate" ownership of computing resources to individual ownership. Benefits of such programmes have been widely touted by universities and commercial notebook computer vendors including enhancement of universities marketing position, decreased IT expenses because of cost-sharing between institutions and students, extended learning opportunities, and enhanced IT skills.

But how each individual programme is implcmented is highly contextualized on local goals, needs, and circumstances. This special interest group meeting will give representatives from tertiary institutions an opportunity to interact, share success stories, identify common concerns, and perhaps develop collaborative efforts around the issues of "assured access" and "mobile computing."

Issues that may be discussed include:

* Planning and implementing such programmes.
* Multiple or single vendor solutions
* Cost-effectiveness
* Bridging the gap between academia and business
* Managing vendor relationships
* Equity of implementation
* Staff support and development
* Barriers to success
* Programme evaluation

Providing Quality Distance Education in an Outcomes-Oriented Program

Dr. Ginny Engman
Fort Lewis College
52 Hesperus Hall
Durango, Colorado 81301..
engman_v@FORTLEWIS.EDU

Abstract: Providing on-line programs for pre-service teachers has presented many issues. Assessing the effectiveness of one's teaching in the classroom is difficult under the best of circumstances; doing so through distance education is even more challenging. The program at Fort Lewis College has addressed these issues and, while resolving many of them, has developed some concerns that require further study.

Quality Distance Education in an Outcomes-Oriented Program

The development of an on-line program in elementary and early childhood licensure has raised many issues. It has also caused some dissension among the faculty. The program consists of all courses in the traditional program being offered through Top Class and Web CT. Currently two faculty (of the 10 full-time faculty) have been responsible for the majority of the program delivery. There has been an increase in the number of students who have opted for this avenue since its inception three years ago. Students are admitted to the program in the same way that students are admitted to the on-campus program: minimum gpa of 2.5, proof of having worked with children, pass a state basic skills test, pass and oral exam, and adequate ACT/SAT score.

Causes For Concern

There are three major causes for concern. First, after an initial orientation meeting on campus, the faculty have little or no face-to-face contact with the students. They must rely on the written evaluations and comments of the public school teachers with whom the students are placed. Historically, these assessments have been somewhat skewed toward the positive. In fact, the teachers are willing to be more objective if they do not have to put their observation in writing. However, for legal purposes we need to keep a "paper trail". The problem arises when we face a disconnect between what the teachers are writing and the actual effectiveness of the student (teacher candidate). It comes to a head at the student teaching experience—after the student has finished all course work and pre-student teaching practica. The dilemma we face is that the students are out of our service are (hence, the term distance education) so that it is not possible for our faculty to observe and evaluate them on-site. when predicted teacher How do we balance this with our commitment to preparing qualified, caring and competent teachers?

Second, besides the teacher education courses, there is a need for courses outside the department to be delivered on-line. There are auxiliary courses in Exercise Science, Art and Music that our students need as part of their licensure program. Additionally, if the are seeking a degree in Arts and Sciences, they will need to take classes in they major. There has been much resistance on the part of faculty to develop an electronic delivery of their courses. How can we break through the barrier that keeps faculty from taking a risk in the area of distance education?

Third, and lastly, until recently, the upper level administration has been reluctant (not necessarily resistant) to invest significantly in distance education. There is a skepticism about the ability to have high quality and require high standards in an electronically delivered program. How can we educate decision-makers so that we can get their buy-in for distance education?

How to Prepare Teachers for Integrating Multimedia and Technology into K-12 Classrooms

Barbara G. Foster, Ed.D. – Spalding University: Louisville, KY USA bfoster@spalding.edu

Abstract: To meet the needs of diverse learners, teachers must be able to integrate multimedia and technology into K-12 classrooms. Participants will walk away from this session with practical assignments and constructivist activities to enhance professional productivity and support instruction, successful assessment strategies that promote positive attitudes for facilitating the lifelong learning of various technologies by teachers and students, and samples of student work. Topics will include: knowledge of basic multimedia terminology, applications, and technologies; development of basic skills in operating multimedia hardware to support instruction and learning; development of basic skills in using and integrating the Internet and multimedia applications into the curriculum to meet the needs of learners at different age levels and in different subject areas; experience in making presentations using multimedia technologies; experience in designing and planning instruction that integrates multimedia technologies into the curriculum; and awareness of the copyright laws as they relate to educational technology.

Educational Technology and Context: an exploration of values, roles, and concerns from Lecturers, tutors and instructors.

Alison Hudson
Learning and Teaching Institute,
Sheffield Hallam University
Adsetts Centre, Howard Street
Sheffield, UK, S1 1WB
a.r.hudson@shu.ac.uk

John Steel
Learning and Teaching Institute
Sheffield Hallam University
Adsetts Centre, Howard Stree
Sheffield,UK, S1 1WB
j.a.steel@shu.ac.uk

Introduction

Educational and instructional technologies are increasingly becoming part of learning and teaching in higher education institutions. There is no doubt therefore that the adoption of such technologies in this context impacts upon many areas of university life. It could be argued however, that in addition to significant benefits to the institution and its students, the increasing use of educational technologies raise a number problematic issues and areas of uncertainty.

This special interest discussion therefore seeks to get to grips with a number of key issues around the role of educational technology in the learning and teaching equation from the perspective of the lecturer/tutor/instructor. It is considered therefore that by generating discussion around a number of important areas of interest to educational practitioners, some improved awareness of obstacles as well as examples of best practice can be made. From this starting point, greater understanding and progression may be encouraged or developed.

Applications and categorization of software-based scaffolding

Koos Winnips, University of Twente, Netherlands; Catherine McLoughlin, University of New England, Australia

The increasing popularity of computer-based learning environments, combined with a need for time-flexible and self-reliant learning, has caused an increase in the demand for scaffolding embedded in instructional software environments (see for example Acovelli & Gamble, 1997; Guzdial & Kehoe, 1998; Tabak & Reiser, 1997; Rada & Yazdani, 1998). The aim of software-based scaffolding is to provide some of the same kinds of support a teacher could provide in a classroom setting, but now in a computer-based learning environment. In this setting it is assumed that face-to-face contact between student and teacher is reduced or impossible. Software scaffolding can be defined by the following three characteristics (Guzdial, 1995, Zhao, 1997, Winnips, 1998):
- Modeling: the desired behavior is modeled by providing a kind of structure, communicating what is desired, or presentation of an expert model.
- Support is given to the learner so that the learner can perform a task independently.
- Fading takes place so that students become self-reliant.

While many applications and examples of software scaffolding are now known, a categorization of these examples has not emerged yet. Applications of scaffolding can be categorized according to who regulates the scaffolding (teacher, peer-student, computer, self), technology used, pedagogy used, or according to its intended learning outcome. An example of a categorization, based on types of support given is found below:
- Providing examples: ideally these examples should not only focus on products, but also on a process. Providing examples links to the concept of modeling as Bandura (1965) described it, where a teacher would serve as a role model.
- Helping students, by giving away (physical) parts of the solution. This can serve to help students with a solution, or the help may just serve to support students on very time-consuming tasks that are not absolutely necessary for learning (Acovelli & Gamble, 1997).
- Providing a model for design, or a structure to design in. For example providing design guidelines (Collis & Winnips, 1998).
- Cueing/hinting: helping students with a solution by providing a hint or cue to a possible path of the solution (Acovelli & Gamble, 1997).
- Coaching comments (Jonassen, 1998). These comments are intended for motivation, providing feedback and advice on performance, and provoking reflection.
- Asking questions, pointing out weaknesses, asking for a motivation, in order to enhance reflection.
- Metacognitive support: stating why the above types of support are given, in order to model the type of metacognition that experts would use.
- Providing a timeline, with fixed dates and goals built in. This structure could be present, to help students appearring to be very goal directed to build in multiple evaluation moments into the actual experience of studying.

Aim of this SIG discussion is to reach consensus about a number of categories for scaffolding and to construct guidelines about the relationship of learning outcomes to particular forms of scaffolding. This in order to provide structure for future research and to be able to better link previous experiences in software scaffolding to future experiments.

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TUTORIAL PAPERS

EDMEDIA2000 TUTORIAL

PLANNING ONLINE COURSES and LEARNING RESOURCES

Andrew Litchfield
Lecturer in Learning and Teaching
Centre for Professional Development
Macquarie University
SYDNEY NSW 2109

Tel: +61 2 9850 9780
Email: andrew.litchfield@mq.edu.au

Session Number: 5553
Maximum Participants: 20
Duration: 3 hours

WORKSHOP OBJECTIVES

By the completion of the workshop participants should be able to;

1. understand the processes, phases and activities involved in planning online courses and learning resources

2. develop a persuasive proposal for project funding including concept, rationale, team formation, learner profile, timeline and budget

3. locate potential sources of project funding

4. understand the pedagogic principles of designing online courses and learning resources

5. identify project learning and teaching strategies

6. develop the content for online courses and learning resources

7. understand the legal issues involved with the design of online courses and learning resources

INTENDED AUDIENCE/EXPERTISE LEVEL

This tutorial is for faculty and staff developers who want to fund, design, develop, implement and evaluate online courses and multiple media learning resources. The tutorial is set at an introductory and moderate level.

ABSTRACT

In this tutorial we discuss and commence the crucial planning tasks required to successfully fund, design, develop, implement and evaluate online courses and learning resources. The tutorial will be of most benefit to participants who come with a specific project idea they want to develop further.

We discuss a learner-centred project framework that consists of proposal, media production and educational design processes, phases and activities. You will use the framework to start developing a persuasive proposal including the project concept, rationale, objectives, team formation and learner profile. You then use the framework to develop sound project timelines and a justifiable budget. Potential sources of project funding are identified.

Design principles for online courses and learning resources are discussed based on the instructional design process, Bigg's concept of 'alignment', and Laurillard's 'conversational model' of the learning and teaching process. You will commence identifying your project's learning and teaching strategies. We discuss methods of developing the content for your project and the relevant legal issues.

TUTORIAL OUTLINE

1. Introduction - participant's projects
2. Learner-centered project proposal, media production & educational design processes, phases and activities
3. *Activity #1: Develop project concept, rationale, objectives, team and learner profile*
4. Timelines for online educational projects
5. *Activity #2: Develop project timeline*
6. Budgeting for online educational projects
7. *Activity #3: Develop project budget*
8. Funding sources
9. Design principles for online courses and learning resources
10. *Activity #4: Identify project learning and teaching strategies*
11. Developing educational content

12. Relevant legal issues

13. Plenary Discussion

14. Conclusion and tutorial evaluation

PRESENTER'S QUALIFICATIONS & EXPERIENCE:

Andrew Litchfield lectures in Learning and Teaching at the Centre for Professional Development, Macquarie University. He is responsible for supporting Macquarie University staff in course design, the use of educational technology, and the planning, design and management of teaching innovations and learning resources. His academic experience also includes lectureships in Media Communications and in Educational Technology.

Andrew's media company, Positive Image, has produced numerous large-scale educational media projects. He has extensive project management and media design experience and has produced four award-winning projects funded by the Australian Government as 'Projects of National Significance'.

POSTER / DEMO PAPERS

Research & evaluation of online systems for teaching & learning

Anne A'Herran, James Cook University, Australia

Piecemeal adoption of methods of online educational delivery can duplicate effort and waste an institution's resources. Early enthusiasm for online delivery of courses soon fades without strategic initiatives on the institution's part. In August 1999 a Web Educational Development Advisor was appointed at JCU to research and evaluate systems for online teaching and learning, with a view to integrating the selected system university wide. That research and evaluation is the subject of this paper.

The relationship between learners' personality types to their performance in computer-mediated distance education

Justin Ahn, Fairfield University, USA; MiLee Ahn, Hanyang University, South Korea

Many distance education programs tend to be focused on programs rather than on individuals and their characteristics with the goal of improving the learners' performance. More research into the effects of distance education should be oriented toward the individual learners. Little is known about the personal factors that promote or inhibit success in distance education environments. This study examined the relationship between learners' personality types and their performance in computer-mediated distance education. This study found that Perceiving types posted fewer but longer messages, Judging types posted more but shorter messages, Feeling types perceived that they had gained knowledge more than other types, and Sensing types were less satisfied with the CMC experience. There were no significant relationships between personality types to grades, level of small group collaboration, and level of leadership influence. Students indicated that the leadership changed from topic to topic and learning in CMC can be achieved without a leader. They used others' frequency and quality of postings, writing skills, and feedback to postings as a factor in determining the leadership.

Tutoring Skills for Instructors in Distance Delivery

Mohamed Ally, Athabasca University, Canada

The growth in use of the Internet and other telecommunications technologies in education is changing the role of the instructor from that of a provider of information to that of a tutor. This new role of the instructor requires different skills to work with students in a virtual and distributed environment. This session will present the tutoring skills that are required by tutors to function in a distance delivery mode.

Development of an Introductory Financial Accounting Text in Print-based and Electronic Multimedia Environments

David Annand, School of Business, Athabasca University, Canada

Athabasca University is Canada's largest distance-based, open university. Students presently registering in the University's introductory financial accounting course are provided with a paper-based textbook, solutions manual, study guide, and assignment manual. These materials are all developed and printed in-house. The 800-page textbook was recently converted to on-screen presentation format. The amount of material was significantly reduced by moving discussion cases to an on-line instructors' manual. The material was edited for on-screen use by altering backgrounds, screen breaks, and page size. The files were then converted into Authorware Professional®. Information presentation was streamlined and interactive elements were incorporated. Feedback for selected text problems was inserted at appropriate points. Audio/visual segments, two computer simulations, and navigation and index systems were developed. The final product will be packaged on a CD-ROM, included with each print-based course package sent to students, and incorporated into the University's Virtual Teaching and Learning (ViTAL) electronic environment.

The Biotechnology Project: A Case Study on Integrating the Use of The Internet for Research and On-Line Communication in a Brazilian School

Cristiana Assumpção, Columbia University, USA

This project was developed in a model private school in Brazil, Colégio Bandeirantes, having the reputation for its high academic level and vision for the future. Using an advanced topic in Biology, students were challenged to go beyond normal academic activities, acquiring skills to integrate technology and become lifelong learners. They have had the opportunity to interact with researchers in the field of Biotechnology, as well as with peers in New York. Students have learned to use the Internet as a research tool as well as a place for collaboration and content building. This is a study of the role of technology in empowering students to become active learners and researchers, as well as adaptation to these new methods of communication. Interesting patterns have emerged on how students communicate online versus face to face. The study continues on how to create pedagogically sound best practices for technology integration.

Utilization of BBS for ESL class

Hideyuki Baba, Keio Gijuku Girls High School, Japan

We introduced the usage of a BBS system into ESL learning to enhance English reading and writing competence of our high school students. The BBS system can enable our students to learn English in a totally relaxed and comfortable way. They are expected to find an English file by using a Web browzer and write down their reaction on a page designed in the BBS. Students are also expected to name the URL on the top of the reaction writing so that we can easily trace back what kind of file our students have read and what kind of viewpoint they have taken. The BBS system itself is not so complicated. The program was originally created by a Japanese college student and made to adapt our learning goals later. The good points of this system is (1) it is quite easy to grasp the several stages of developing process of our studets' English learning only by giving a look at the writing page, (2) students can read and write English in a non-stressed way, (3) the English the sudents are likely to write is not so intimate or personal, which is one of the disadvantages of "pen-pal, or mail-pal" type of writing, (4) anyone concerned can write comments to the writings so that a kind of dialogue is possible among the people inside the system.

The eMINTS Project: Enhancing Missouri's Instructional Networked Teaching Strategies -- Promising Developments and Projected Outcomes

Adam Bickford, OSEDA/University of Missouri Extension, USA; Bill Elder, OSEDA/University of Missouri Extension, USA; Barbara Hammer, OSEDA/University of Missouri Extension, USA; Patrick McGinty, OSEDA/University of Missouri Extension, USA; Priscilla McKinley, OSEDA/University of Missouri Extension, USA; Susan Mitchell, OSEDA/University of Missouri Extension, USA

The eMINTS Project is an ongoing cooperative initiative between the Missouri Department of Elementary and Secondary Education (MoDESE), the Missouri Research and Education Network (MOREnet) and 98 elementary classrooms in 44 school districts. eMINTS classrooms are provided with an extensive technological infrastructure: high-speed internet connectivity, enough student computers to provide one computer for every two students, a high capacity teacher workstation with video conferencing capabilities, and a computer projector and a Smart Board. In addition to the computing infrastructure, participating teachers receive extensive training in constructivist, inquiry-based teaching methods which are supported by the University of Missouri College of Education, which provides full-time assistance in locating and using on-line instructional resources. Results from the first wave of this project, the MINTs Project, have demonstrated that well trained teachers working in technologically rich classrooms, can focus student interest and improve student scores on measures of academic achievement.

LEZI: a Tool for Easy Development of Interactive Video for Education

Mario A. Bochicchio, University of Lecce, Italy; Roberto Paiano, University of Lecce, Italy; Paolo Paolini, Politecnico di Milano, Italy; Elisabetta Andreassi, University of Lecce, Italy; Tiziana Montanaro, University of Lecce, Italy

The design and implementation of complex multimedia application is an extensive effort, requiring time, technical skills and sizable budgets. In few cases, therefore, in educational environment it's possible to realize complete hypermedia applications. It's true, nevertheless, that within several academic institutions there is the capability of developing high quality educational content, traditionally delivered as paper, while it could be more efficiently delivered in multimedia format. Our Laboratory is devoted to development of Multimedia applications, some of them concerning educational subjects in collaboration with several professors from the Humanities. Many of them asked for developing their own "cultural" application, but may be they don't have the budget, human resources or technical skills to carry on the job. With this requirements in mind we conceived LEZI, a tool that requires a minimal computer expertise in order to develop in a quick manner educational multimedia application based on interactive video and electronic documents.

New Views on Community and Collaboration: Building and Sharing Dynamic Worlds in Cyberspace

Paula Bonta, LCSI, Canada; Richard Borovoy, MIT Media Lab, USA; Susan Einhorn, Consultant, Canada; Brian Silverman, MIT Media Lab, USA

Abstract: The Internet has the potential to provide an unprecedented dynamic, interactive learning environment - one in which students from around the globe can collaborate in the construction of exciting new worlds. Despite the Internet's capabilities, there is a lack of applications geared towards fulfilling this need. This poster session will present a prototype, the Kids Internet Construction Kit (KICK), that allows K-12 students to create and share dynamic worlds on the Internet.

Reeves Ten-Dimensional Model: Application for the Design and Development of Web-Based Learning Scenario on Learning Theories

Caroline Brassard, Universite du Quebec a Chicoutimi, Canada; Jacqueline Bourdeau, Universite du Quebec a Chicoutimi, Canada; Pauline Minier, Universite du Quebec a Chicoutimi, Canada

This poster presentation covers the design and development of a media-based learning scenario and Web environment with a view to implementing a pedagogical design that integrates new technologies. The scenario responds to concerns regarding pedagogical innovation in "Teachers Training". It tries to facilitate the development of the skills required within the larger framework of courses where theoretical content is high and cooperative learning methods must be supported. The focus was therefore placed on the ability to "make links" and on the socio-constructivist approach. The results showed the importance of design, the need for cognitive strategies, the inherent pedagogical value of cooperative learning and developing the ability to "make links". The creation of links can go beyond the context to encompass any training session that contains a wide range of theories and a broad body of knowledge. It appears that the need for a design that produces the most appropriate overall educational formula may lead to proven pedagogical effectiveness.

The Creative Network:the development of a collaborative learning community for mature professionals

Helen Brown, University of Central England, Birmingham Institute of Art and Design, England

The hypothesis underlying the formation of the Creative Network is that a radical approach to Continuing Professional Development in the U.K. is needed to prepare those employed in the Creative Industries for:

1. the portfolio career
2. short term contracts
3. rapidly changing technologies/materials
4. structural changes in the companies, flatter hierarchies, featuring multi-skilling and cross functional teams
5. e-business (e-commerce and e-volution)

The Creative Network web site is the gateway to a learning community. There is no standard course or assessment. Instead the Creative Network tutors work with each individual learner or company to analyse their development needs and structure a training plan. The Creative Network aims to facilitate deep learning based upon a spirit of facilitation which helps learners to contextualise new learning and construct personal relevance and meaning.

Breathing New Life Into The Classroom

Lawrence Bundy, Nebraska Department of Education, USA

Two Nebraska projects, funded by grants from the United States Department of Education, will work together to prepare teachers to use technology in the classroom. The Connections Project, a five-year Education Technology Innovation Challenge grant, works with in-service teachers. Introductory, intensive five-day summer workshops focus on classroom uses of technology, brain-compatible teaching strategies, life skills, multiple learning styles, and integrated curriculum models. On-going staff development follows the workshops at local sites throughout the academic year. The teachers create curriculum units incorporating the strategies they have learned and post them on the project Web site—http://ois.unomaha.edu/connections. They also create CD-ROMs of the workshop presentations, which will be distributed to over 6,000 teachers. The Catalyst Project, a three-year Preparing Tomorrow's Teachers to use Technology (PTTT) grant, involves seventeen higher education institutions that are engaged in active systemic changes to prepare pre-service teachers to use educational technology. The two projects will work together to identify and develop a cadre of K-12 teachers who are leaders in the use of educational technology. This cadre will act as resources in the higher education classroom and as cooperating teachers for teacher education programs.

Improving Collaboration in Face-to-Face Groups using Technology

Robert W. Cavenagh, Jr., Dickinson College, USA

Abstract: Face-to-face collaborative work is an essential tenet of much contemporary teaching, especially within constructivist models. The practical use of technology by small intact groups has received relatively little research attention. Observation of learners in existing settings suggests that commonplace computing facilities may limit effective collaborative work by more than two individuals. The design of facilities and strategies specifically for collaboration has been demonstrated to improve the effectiveness of such work. This PosterDemo reviews applicable research, presents design and cost criteria for and photographic examples of purpose-built facilities, and delineates pedagogic strategies found useful, including both assignment and assessment strategies. It summarizes findings and future topics to explore. It also simulates the look and feel of one such collaborative facility.

Educational Applications of Hypervideo

Teresa Chambel, University of Lisbon, Portuga

Video clips can greatly enhance the authenticity of a computer based learning environment. Something constructivists have been strongly arguing for. Broadcast television does not afford composition or the time to reflect. But, television and video, when properly constructed, can be a powerful tool for reflection. If the user can select what is to be seen and control the pace of the material, and it is easy to go back and forth, to stop, to make annotations, to compare and to relate to other materials. Effective reflection requires some structure and organization, the main issues in hypermedia. Hypervideo refers to the integration of video in truly hypermedia documents, taking into account its spatial and temporal dimensions, and defining the semantic and mechanisms to link and navigate video and other media. In this presentation, different mechanisms for the integration and navigation of video in educational applications are demonstrated. These were developed using HTIMEL, an extension to HTML and existing Web tools, being developed and used in the Unibase project on distance learning.

Collaboration between T&T3 Project Team and ETU/CeLTS at HKIEd in Promoting Teaching Skills and IT for HE

Thomas YH Chan, Lingnan University, Hong Kong, China; Julianne WY Wong, Hong Kong Institute of Education, Hong Kong, China; Elson Szeto, Hong Kong Institute of Education, Hong Kong, China

We are presenting the fruit of our collaboration in the context of the T&T Project --- a publicly-funded inter-institutional collaborative initiative for all academic and professional staff in Hong Kong's HE institutions. Project mission is to pull together human and instructional resources from all institutions in a collaborative effort in promoting, fostering and advancing quality teaching and learning. We are going to share with conference participants the following:

- Designing and conducting sessions on IT in teaching and learning for academic and professional staff from all tertiary institutions in Hong Kong, in particular on:
- formatting and layout of text
- digital graphics
- perfecting presentation skills
- other digital media for enhancing teaching and learning
- Designing and producing for colleagues' use self-instructional multimedia packages for enabling IT self-sufficiency (in CD-ROM format)
- Initiating audio and video streaming for the "T&T Project Website" and related on-line multimedia packages

Teaching Symbol Recognition with Interactive Java GUI

Li Chao, University of Houston-Victoria, USA

Abstract: The ease of learning Java, its reliability, and its portability make this programming language more and more popular among students and faculty. It has gained much attention through its power of multithreading, networking, and computer graphics. As an assistant in teaching computer vision such as symbol recognition, Java has the flexibility needed to develop classroom demonstrations which are accessible through Internet. The objective of this paper is to present an interactive Java based GUI to assist the teaching of symbol recognition.

Kabisa: A computer-based training program for diagnostic reasoning in tropical medicine

Geraldine Clarebout, Univerisity of Leuven, Belgium; Jan Elen, University of Leuven, Belgium; Joost Lowyck, Univerisity of Leuven, Belgium; Jef Van den Ende, Institute of Tropical Medicine, Belgium; Stefano Laganà, Italy

A shift took place in educational goals from knowing everything in a certain domain, to knowing how to deal with complex problems. The reasoning process has become more important than the amount of information to memorize. In medical education the same evolution took place. A computer-based training program that is developed to guide and help to develop diagnostic reasoning skills in tropical medicine is KABISA. In this poster, the program will be presented and all its functionalities, as well as a user-test that was performed. This test was done to identify whether KABISA really contributes to the development of reasoning skills in tropical medicine. The main aim of this test is to determine what has to be changed to the program to provide students with an efficient learning environment to learn diagnostic reasoning and to optimize the program. Use was made of a thinking aloud method and log file analysis.

WEB-LIT: Web-Based Support for Learning Theory and Instructional Design

Ken Clinkenbeard, University of Bergen, Norway; J. Michael Spector, University of Bergen, Norway

The primary objectives of our project include creating an open and flexible web site to host materials on learning theory and instructional design. We will find and evaluate existing web-based materials on these topics which reflect a wide variety of perspectives, applications and lessons learned and organize the site so that materials can be posted and easily accessed. Interactivity also plays a key role. Opportunities are provided for users to comment on existing materials and/or submit new materials. Our goal is not to create an online course in the area of instructional design of learning theory, but to augment the design of these courses by offering support resources. A secondary goal of this site is to create a web-based set of resources that can provide a source of evaluation data on the use of web-based materials in graduate education.

Realism and Credibility in a Simulation-Based Virtual Physics Laboratory (VPLab): An Empirical Study

Marc Couture, Télé-université, Canada; Alexandre Francis, Université de Montréal, Canada

Realism and effectiveness of computer simulation-based learning or training environments have been examined in several studies. It was shown that under certain conditions, simulations can be as efficient as real experiments, and that increased realism may result in gains in 'practical appreciation'. However, few have investigated the relationship between realism and credibility, or between credibility and effectiveness. The VPLab is a simulation-based learning environment featuring many characteristics and constraints normally associated with real experiments. These include uncertainty in measurement, random fluctuation of parameters, and limitations in user control over the simulation. This approach distinguishes the VPLab from most existing simulation-based laboratories. We will present first results of an experimentation with first-year university science students, in which we sought to identify the factors, most notably those associated with our approach of realism, that may enhance the credibility of such an environment and/or its perceived relevance as a tool for learning laboratory skills as well as science concepts.

A Web-based Tutorial on Optical Communications

Ignacio de Miguel, University of Valladolid, Spain; Carlos Jesus Fuertes, University of Valladolid, Spain; Abel Prieto, University of Valladolid, Spain; Patricia Fernandez, University of Valladolid, Spain; Miguel Lopez, University of Valladolid, Spain; Fernando Gonzalez, University of Valladolid, Spain; Juan Carlos Aguado, University of Valladolid, Spain; Ruben M. Lorenzo, University of Valladolid, Spain; Evaristo J. Abril, University of Valladolid, Spain

We are developing a tutorial on optical communications in order to increase the interest of the students in this area and to clear up some concepts. The tutorial is divided into four didactical units: Propagation of Signals; Components and Devices; Optical Communication Systems; and Optical Communication Networks. Within each unit, basic information is provided as well as simulators and animations. The students can also perform self-evaluations to check their progress. The self-evaluations are randomly generated from the contents of a database according to the students' preferences (topics, difficulty and kind of items: questions and/or short problems). The tutorial is being developed at http://pesquera.tel.uva.es/tutorial. The utilization of web technologies allows the students to access the tutorial from their homes, and we hope it will facilitate the collaboration with other groups working in these topics. This work is partially supported by Consejeria de Educacion y Cultura (Junta de Castilla y Leon).

Posting Visual Cues on Threaded-Message Boards in Science Curricula: Enhancing Transfer of Theory Knowledge to Clinical Practice

Gregory A. DeBourgh, University of San Francisco, USA

Results of a pilot study (16 baccalaureate nursing students) suggest posting thematic, integrated photographs, graphic, and text data on asynchronous, threaded-message boards facilitates transfer of theory knowledge to clinical practice and supports the acquisition of skills in clinical reasoning (pattern recognition, critical analysis, problem solving, and identification of therapeutic interventions). Visual cues provide powerful representations of reality that enable students to recognize manifestations and patterns of clinical pathologies. Text-based learning prompts stimulate reflective thinking and collaborative problem solving. Used synergistically, they create clinical context, authentic complexity, and scaffold learning. Provided both words and pictures during instruction, learners encode information in such a manner that recall is facilitated and transfer of knowledge enhanced. Students report on-line interaction results in the positive experience of belonging to a professional community during learning, affords support and opportunities for collaboration, and increases access to the instructor to clarify "accuracy of learning" and provide feedback. Using visually-enriched on-line conferencing is an enjoyable, convenient, and satisfying way to amplify and enhance learning, and "brings the course content alive".

The «BacVert» or «Blue Box» - A Knowledge Recycling Bin for Students

Céline Desjardins, Centre de recherche LICEF, Canada; Éfoé Wallace, Centre de recherche LICEF, Canada; Claude Ricciardi-Rigault, Centre de recherche LICEF, Canada

While it has become common to provide students with a list of documents to peruse on the Internet, information gathering, net-surfing and annotation all have an exploratory, individual and work-in-progress quality. Sharing insights gained through these activities, especially in distance education, is complicated and requires highly structured settings. The INF9002 «BacVert» web-based dispositif at Télé-université supports such sharing. The natural language parsing performed by Nomino provides flexible automatic structuration, both of the core Internet material proposed by the teacher to which the students gradually add their findings, and of the comments about these documents produced by the students. By allowing a group of students to constitute an evolutive information base, to comment on it and to compare notes, the INF9002 «BacVert» constitutes a step towards tackling the complexity and heterogeneity of the information environment, while supporting exchanges among peers about the material at hand.

Building Global Information Communities: the University of Iowa Center for Electronic Resources in African Studies (CERAS)

Barbara Dewey, University of Iowa Libraries, USA

This poster session provides a case study of the issues and lessons learned regarding development of the University of Iowa's Center for Electronic Resources in African Studies (CERAS) (http://sdrc.lib.uiowa.edu/ceras/). The Center is a "virtual" space for creating, disseminating, and accessing scholarly electronic resources in text, multimedia, and interactive format, and a "virtual" place for further development of electronic resources (textual and multimedia-based) pertaining to Africa created by scholars from the United States as well as from Africa and other parts of the world (http://sdrc.lib.uiowa.edu/ceras/). CERAS is part of the University Libraries' Scholarly Digital Resources Center supporting students and faculty engaged in African Studies research and teaching at the University of Iowa, and scholars nationally and internationally. CERAS is also a venue for U.S. and African scholars for creating and disseminating African Studies scholarship and information resources in electronic format. Several CERAS initiatives have focused on image creation, particularly in the field of African art, a strength at the University of Iowa. CERAS will serve as a venue for digitizing projects related to Africana scholarship (i.e. museum collections, selected non-copyrighted collections, archival materials, and documents). Other goals include bringing high quality African Studies scholarly electronic collections and web sites currently in existence into a user-friendly digital library web page; providing a venue for "publishing" original materials, including pre-prints, (articles, books, conference proceedings) as well as creating significant thematic textual and multimedia collections of materials in electronic format; and developing an electronic international community of Africana scholars where dialogue about issues, research, and projects can take place. This latter feature is intended to provide a broader opportunity for Africana scholars to post drafts of research papers and projects for critique and discussion by other Africanists from around the world. The University of Iowa Libraries is seeking collaborative projects and partnerships with institutions and Africana scholars from around the world.

Introducing a Distance Learning version of a Postgraduate Program on Networking in Argentina

Dean Javier Díaz, University of La Plata, Argentine; Maria Alejandra Osorio, University of La Plata, Argentine; Ana Paola Amadeo, University of La Plata, Argentine

The great popularity of the Internet and the widespread use of the World Wide Web are promoting a new methodology for distance learning. The main advantage of the Internet based courses is possibility to promote a bi-directional communication between the students and the professor and to highly, motivate the student due to an adequate feedback. This poster describe the introduction of Internet tools (such as www, e-mail, IRC, FTP, mailing list) in the distance learning postgraduate program of the 'Magister de Redes' (http://www.linti.unlp.edu.ar/master) of the UNLP . The ongoing experience was successful due to certain facts that are stated in the poster which also mentions some drawbacks and the strategy for overcoming them. The distance-learning version of the program started in 1998 as way to reduce the obstacles for he students (professionals from the engineering and the computer science field in the networking area), mainly the traveling expenses and the time it takes due the large geography of our country and the long distances.

The Bones Of The Skull: Creating Anatomical Models With Quicktime Vr

Marilyn Dispensa, The University of Iowa, USA; Jim Duncan, The University of Iowa, USA; Jerry Moon, The University of Iowa, USA

This electronic demonstration will provide an overview of QuickTime Virtual Reality (QTVR) and its utility in the development of virtual anatomical models which can be used alone or integrated into computer-based-learning (CBL) software. The Bones of the Skull: A 3-D Learning Tool is a CD-ROM-based module designed to help college-level anatomy students learn the bones and important landmarks of the skull. The software has two main features: 1. A collection of Quicktime VR movies that allow the user to rotate and view the skull and its bones in three dimensions. 2. An interactive "textbook" that contains high quality 2-D images, descriptive text and many embedded activities to encourage interaction with the content. This presentation will demonstrate the product and provide an overview of QuickTime VR, including technical requirements and hardware/software costs. The Bones of the Skull won the 1999 Sandoz/Slice of Life Student Software Award.

The impact of establishing a virtual university: a case study at NUST

Nomusa Dlodlo, National University of Science and Technology, Zimbabwe

The purpose of establishing any university is to cater for the educational needs of the surrounding community. In developing countries universities fail to cope with large numbers of applicants. The reason is that the number of universities in such countries is limited due partly to historical circumstances and partly due to financial constraints. The exercise of building brick and mortar universities and acquiring skilled staff to run them is expensive.

A Distributed Maritime Simulation Training Environment based on HLA

Mirko Dobermann, Computer Graphics Center ZGDV, Germany; Harro Kucharzewski, MarineSoft GmbH, Germany

A new approach for advanced training systems is the integration of computer simulation into such applications, allowing students to experiment in complex scenarios. The presentation introduces a distributed simulation-based training scenario , generated in a distributed environment, which that offers extended functionality for interaction and demonstration within a maritime training scenarioapplication. The main objectives of the solution are threefold: to set up and establish a distributed simulation-based training environment, to provide real-time interaction functionality during run-time, as well asand to integrate already available simulators that are currently on the market. The infrastructure for this simulation is based on HLA/RTI, while which already offers functionality to couple embedded applications with networked simulation applications. The Computer Graphics Center in Rostock (ZGDV) currently focuses on maritime scenarios related to competency training for crews aboard and ashore. The development of the simulation environment is part of a research project in collaboration with regional enterprises in the Maritime sector.

Human Anatomy Predissection Lecture-On-Demand at The National University of Singapore

Gilles Doiron, National University of Singapore, Singapore

The NUS Integrated Virtual Learning Environment (IVLE) was developed so that staff and students could use this information technology infrastructure to communicate, exchange documents and information, discuss, chat, and access custom learning materials and course related web sites. IVLE also enabled the university to consider new pedagogical approaches, which would utilise its campus-wide broadband access to meet specific teaching and learning needs. A "lecture-on-demand" (LoD) delivery was seen as a viable tool that would allow students to take more responsibility for their learning and enable them to have greater control over their time schedule. With the collaboration of the Faculty of Medicine, the Center for Instructional Technology and the Centre for Development of Teaching & Learning, a prototype anatomy pre-dissection LoD, "The Abdominal Wall & Inguinal Canal", was produced. This paper examines the design and development issues addressed in building the prototype. Field test data on the technical reliability, and ratings, and comments from student feedback are presented.

ExploraGraph and CINEMA

Aude Dufresne, Univ. of Montreal, Canada; Claire Isabelle, Univ. of Moncton, Canada; Roger Nkambou, Univ.of Montreal, Canada; Yan Laporte, Univ. of Montreal, Canada; Frank Ferront, Univ. of Montreal, Canada

The ExploraGraph interface was designed to facilitate interaction in the context of distant learning. It was developed as an alternative to simple web interaction, in order to increase flexibility, visibility, and structure in the learning environment. It may be used as a front end to existing courses on the web and to support learner in them. The ExploraGraph Navigator makes it possible to navigate through conceptual graphs with automatic arrangement of elements, zoom and "fish eye" effects. Each node of the graph may have a description attached to it and may give direct access to an application, a document or an Internet site. Graphic structures may thus be used to represent the organization of tools, activities, concepts or documents. The Navigator offers each user a tool to specify his goals and the system can support him, using multiple modalities: Hypertext, graphical cues, Ms Agents avatars, voice, visual demonstrations and force feedback guiding.

Future Special Education Teachers' Abilities to Integrate New Technology Into Teaching Reading Comprehension

Catherine Dumoulin, Universite du Quebec a Chicoutimi, Canada; Jacqueline Bourdeau, Universite du Quebec a Chicoutimi, Canada

This study questions future teachers' abilities to integrate new technology into their teaching. A pedagogical scenario based on a cognitive approach was proposed to graduating students of the bachelor of Special Education program in order to teach Grade 3 students with reading comprehension difficulties. This pedagogical scenario integrated new technology via the "Village Prologue", a computerized environment. Future teachers were found to organize pedagogical activities, create learning situations suitable for teaching reading comprehension, help motivate children to read, and finally, guide children in their learning processes within the computerized environment. Furthermore, the pedagogical scenario helped in motivating future teachers to include new technology in their future teaching. The computerized environment also permitted the future teachers to adapt their teaching to the specific needs of children with reading comprehension difficulties.

School Festival on the Internet - Project-based and cooperative learning -

Hironori Egi, Keio University, JAPAN; Yoshitomo Tsutsui, Kamogata High school, JAPAN; Yuuki Nishimura, Keio University, JAPAN; Keiichirou Ishibashi, Keio University, JAPAN

We report a case of project-based and cooperative learning activities, School Festival on the Internet, Okayama 1999 (SF99) in Japan. Three public high schools in Okayama, Keio University and Kurashiki University of Science and the Arts participated in SF99. The goal of SF99 was to put the school festivals held at each of the high school on the web so that the students efforts could be widely appreciated. School festivals are considered as an educational event in Japan, and we implemented SF99 as a project-based and cooperative activity. The festival provides students with opportunities to present achievements of their research or their other interests. Video streams and online communication through a Bulletin Board System (BBS) were the main applications used to achieve the end. SF99 is one of the few examples were extra-curricular activities such as school festivals were digitalized. Information-based learning and extra-curricular activity have similar goals. We also analyzed the achievements of SF99 and discussed the educational effect of information-based learning using the Internet.

The ParlEuNet-project: Problems with the validation of socio-constructivist design principles in ecological settings

Jan Elen, University of Leuven, Belgium; Geraldine Clarebout, University of Leuven, Belgium

Instructional design aims at generating indications about optimal relationships between learner-related and instruction-related variables in view of the attainment of instructional and/or learning goals. In this poster, a study is presented in which it was started from socio-constructivist view on learning and instruction to identify a number of design principles. These principles were used to design and develop a concrete and innovative rich technological leaning environment, the ParlEuNet learning environment. The main features of the this environment can be described as follows:

- A variety of technologies
- A problem-based learning environment where use is made of ill-structured tasks
- International collaboration

It was hypothesized that such an environment would have an influence on certain learning environment. In this poster the environment and the results of the research will be presented, which indicate that there is an influence of the learning environment, however in a different direction than was expected.

Examining Medical Students' Attitudes and Learning Experiences in BioWorld

Sonia Faremo, McGill University, Canada; Susanne Lajoie, McGill University, Canada; David Fleiszer, Faculty of Medicine, McGill University, Canada

This poster presents BioWorld (Lajoie et al., 1998), a computer-based learning environment (CBLE) that engages learners in realistic problem solving as they attempt to diagnose medical cases. Its design is consistent with both problem-based learning (PBL) and cognitive principles of instruction. Solving a BioWorld case involves interpreting case history information, ordering diagnostic tests, developing diagnostic hypotheses, and reflecting on one's own performance. As part of a larger study, the data for this poster consisted of measures of the attitudes and learning experiences of medical students using BioWorld. The experimental procedure involved having medical students individually diagnose a set of BioWorld cases and complete a questionnaire concerning their experiences. Students rated several aspects of the system (level of interest, difficulty, utility of learning activities, etc.). The results have implications for the design of CBLEs for complex domains. They also suggest that BioWorld is an effective learning environment.

CyberARTS: A Integrated Arts Curriculum

Tito Faria, Don Mills Collegiate Insititute, Canada; Sholom Eisenstat, Don Mills Collegiate Institute, Canada

The CyberARTS program is offered at a number of school sites in Toronto. CyberARTS uses a constructivist methodology to deliver visual integrated arts, media communication, computer technology and now Gr. 9 Geography credits. Students have constant access to labs of Macs and PCs and a range of peripherals. Teams of teachers work collaboratively creating and delivering the curriculum. Senior students complete the program with a co-op experience. Their placements include: Alias Wavefront, Web Feat, Apple, Microsoft, the Design Exchange and Nelvana. Our partners include: Waterloo University, Apple, Kodak, Rogers Cable and SoftImage. Our senior class was involved in designing and producing the first edition of "RE: DESIGN", a web "zine" about design for teachers and students by students. www.dxnet.net. Currently a number of senior co-op students have placements at the Design Exchange where they are working on the website for Toronto's Olympic bid. Our program has won an Apple School of Distinction Award and some of its teachers have won a 1999 Prime Minister's Award for Achievement. We will focus on:

- problem oriented curriculum projects and units
- subject integration and authentic learning assessment techniques
- real-world connections and business partners

Managing Electronic Resources - Auto-registration for Distance Learning

Richard Fasse, Rochester Institute of Technology, US; Damon Betlow, Rochester Institute of Technology, US; Randy Overbeck, Rochester Institute of Technology, US

Electronic resources used in distance learning are often restricted to registered students through login ids and passwords. As electronic resources proliferate, so do the problems with managing these accounts for both students and administrators. One option is a form of auto-registration with "course keys" that allows users to select their own login id and password, but restricts registration to only those who received the "course key" in a handout or email.

Interactive Training Materials for Early Childhood Educators: Cases, Tools, and Reflection

Gail Fitzgerald, University of Missouri-Columbia, USA; Louis Semrau, Arkansas State University, USA

Materials to assist early childhood educators in working with young children with behavioral problems are currently in high demand. Multimedia programs offer an effective method for providing instruction based on authentic cases for developing necessary knowledge and skills. In the multimedia program, "Trisha," users can seek professional knowledge from an information database, watch Trisha in multiple settings, interview her teachers and other care providers, read case records, listen to expert commentators discuss theoretical approaches and care recommendations, and carry out a series of real-world activities related to Trisha's needs. Following problem-solving activities, users engage in a series of reflective prompts to review their decisions based on best practices. The program contains electronic performance support tools that can be used within the program as well as in actual job situations. "Trisha" is designed for implementation with workers in childcare settings and preservice courses. Additional information is available at http://www.coe.missouri.edu/~vrcbd/.

Integrating computer ethics into the computer science and computer engineering curricula

John Fodor, Educational Media Resources, Inc., USA

This demonstration will show how to integrate computer ethics into the computer science and computer engineering curricula by using the interactive CD-ROM Understanding Computer Ethics. (UCE was made possible by grants from the National Science Foundation and has won AXIEM, Communicator and International CINDY Awards.) We will discuss such topics as computer privacy, computer security, ownership of intellectual property, software piracy, hacking and professional responsibility. We will examine ways of developing skills, sensitivities, and understandings to "human value" issues and problems raised by computing and information technologies, including ways to elicit more reflective performance understandings. We will analyze four ways specific ways of integrating computer ethics into the computer science and computer engineering curricula:

1) as a stand-alone class,
2) incorporating computer ethics into existing cs & ce classes,
3) as part of a capstone senior project, and
4) as an independent study class.

Development and Implementation of Computerized Instructional Materials: The Mismatch Between Formal and Informal Technology Support Structures in a Medical College

Cynthia Frank, The University of Arizona, U.S.A.

This study focused on the development and implementation of instructional computer materials in the everyday teaching environment of a southwestern U.S. medical college. What happened between the time an instructor voluntarily decided to implement computer technologies in a course and the time a student could actually use the technologies? The existence of formal technology support structures led to the assumption that instructors would utilize professional help. This turned out not to be the case. The majority of instructors used informal support structures to develop and implement their materials. Much of the work was done by students who had no training in instructional design, multimedia programming, or graphic design. This preliminary finding indicates a fundamental mismatch between the type of support professors selected and the type of support offered by the institution.

Putting Curriculum in Control: Interactive Courseware Development with the TechDisc Instructional Design Template

Traig Friedrich, Sencore, Inc., United States; Bill Wann, Sencore, Inc., United States; Karen Korth, University of South Dakota, United States; Mike Hoadley, University of South Dakota, United States; Dan Eastmond, University of South Dakota, United States

The Technology for Training and Development division at the University of South Dakota has joined forces with Sencore, Inc., a multimedia application provider, in the development of an innovative multimedia authoring tool. Designed specifically to apply recognized instructional design techniques to "drag-and-drop" multimedia development, this tool puts interactive courseware authoring into the hands of the classroom educator. This approach to multimedia application development benefits everyone involved in K-12 education by enhancing the classroom teacher's control of course curriculum and specific course content. During this demonstration of the TechDisc Instructional Design Template, participants are welcome to engage in open discussions of the tool, trends in multimedia project authoring, and other issues surrounding interactive courseware development.

Using Virtual Reality to Assist Air Travelers With Disabilities

Clark Germann, Metropolitan State College of Denver, USA; Jane Broida, Metropolitan State College of Denver, USA

Getting to the airport, checking our luggage, going through security, boarding the plane--these are all tasks most of us take for granted each time we fly. But to persons with physical disabilities who use a wheel chair, the above tasks can be difficult and intimidating. No two airports are exactly the same, and procedures for air travelers with disabilities differ with each air carrier. To help ease the anxiety, faculty and students at Metropolitan State College of Denver have used computer technology to duplicate one major airport into virtual reality. Now, future air travelers can preview the experience first on the computer prior to going to the airport in person. With 135,000 people in wheelchairs in Colorado alone, provision of resources for air travel is especially pertinent. Survey research and anecdotal evidence has shown that these virtual representations can be helpful in reducing anxiety in persons with disabilities by providing a preview of a location prior to visiting it in person.

Gender and Race: The Accuracy of Internet Clip Art

Carol Gilley, University of Arkansas, USA; Elaine Terrell, University of Arkansas, USA

Abstract: Computers are being used to create various print media as well as multimedia. Some questions are being raised in developing these media materials. Is there a supply of free clip art on the Internet that represents the real world? Do viewers see themselves in clip art used in print and computer-based multimedia? This study explores the issues of equity and stereotyping with regard to the images in free Internet clip art by investigating the following two hypothesis. 1) There is no significant difference between the proportion of men, women, boys, and girls represented in free Internet clip art and the proportion of men, women, boys, and girls in the general population. 2) There is no significant difference between the proportion of White, Blacks, and other minorities represented in free Internet clip art and the proportion of White, Blacks, and other minorities in the general population.

How To Be Innovative Designing Educational And Interactive Environments For Children

Gloria Elena Gomez Escobar, University of Los Andes, Colombia

LUDOMATICA PROJECT looks to effectively attend children's educational needs. It seeks to help them to creatively think and act, validating their rights to high-quality education and to actively participate as social change agents. This validation is accomplished through innovations in formal, non-formal and informal education, using Information and Telecommunication Technologies within a non-conventional pedagogical. We want to develop the intellectual potential and cognitive abilities of children who live in high-risk situations, taking advantage of their adverse learning to stimulate creative potentials, communicative resources and have them discover their own adventurous spirit and creative capabilities. The interactive game THE FANTASTIC CITY is one of the environments created for these purposes. This is a digital multimedia microworld that motivates and develops children's fantasy and creativity by means of enigmas and puzzles, seeking to generate cognitive and affective imbalances. This interactive environment leads children to action. It promotes curiosity and experiential learning; it allows speculating, discovering, learning from mistakes; and it stimulates the desire to learn.

Teaching Dynamics of Dairy Herd Health and Management

Claudia Haferkamp-Wise, Cornell University, USA; Heather G. Allore, Cornell University, USA; Yrjo T. Grohn, Cornell University, USA; Lorin D. Warnick, Cornell University, USA

Cornell University offers "Dynamics of Dairy Herd Health and Management" (http://courseinfo.cit.cornell.edu/courses/vetmed745) - a newly designed web-based distribution course to its on-campus veterinary students and to students at 9 off-campus test sites within the United States and abroad. This course uses a computer-based instructional delivery system (DairySim) to teach basic concepts of epidemiology and economics of dairy cattle disorders, experimental design, and statistics. The courseware provides two simulation models - SIMHEALTH and SIMMAST - with an interactive user-friendly interface and output analysis - thus making research tools accessible to a broader audience. DairySim and its accompanying user guides are available on-line. Lectures can be attended in person on-campus or viewed via the internet. Students can print handouts for use in computer laboratory sessions, take on-line quizzes and download homework assignments. Completed assignments are handed in by uploading the documents. Instructor-student and student-student communication for off-campus students takes place via email and an on-line discussion board.

A Comprehensive Model for Improving Technology in Teacher Education

Robert (Bob) Hannafin, College of William and Mary, US; Robert (Bob) Hanny, College of William and Mary, US.

This paper identifies the professional development model developed at the College of William and Mary to close the gaps between its strategic vision for the teacher education program and its capacity. The College's vision is to produce teachers who seamlessly integrate technology by designing and assessing authentic student-centered learning activities. Three areas were identified as requiring parallel effort: faculty development, institutional development, and clinical faculty/PDS development. Goals were established that addressed capacity shortfall and advance the program to the point where significant innovation could occur. Both our students and faculty needed to master both basic technology skills and the subtler art of practicing creative integration strategies. It also required placing our students with teachers who are competent technology users and encouraging in technologically-adequate classrooms. Institutional changes were necessary on two fronts: upgrading the technology available in School classrooms, and instituting incentives to entice faculty to use and integrate technology.

Web-Based Tools For Courses On Transport Phenomena

Bernardo Hernandez-Morales, Universidad Nacional Autonoma de Mexico, Mexico; Rafael Fernandez-Flores, Universidad Nacional Autonoma de Mexico, Mexico; Jorge Tellez-Martinez, Universidad Nacional Autonoma de Mexico, Mexico

Even though multimedia applications have been extensively used in many courses, the field of transport phenomena has received comparatively less attention. Thus, we are developing interactive tools, to be accessed through Internet, to solve problems observed when traditional teaching techniques are used. The material consists of modules to solve typical problems in transport phenomena. Each module is a Webpage that includes the theoretical background (with hyperlinks to all course material) and an interactive worksheet to solve a particular problem. The worksheets are built with Java applets (JDK 1.1. compatible) and may may be used in any of three modes: example mode (fixed set of values), training mode (variable set of values), and exploration mode (range of values of a key independent variable). Thus, unlike problems found in traditional textbooks, the student may explore a range of values for key independent variables to establish its influence on the dependent variables.

Shaknoma: A collaborative tool for shared knowledge management

Oriel Herrera, Pontificia Universidad Catolica de Chile, Chile; Sergio Ochoa, Pontificia Universidad Catolica de Chile, Chile; Vidal Rodriguez, Pontificia Universidad Catolica de Chile, Chile; David Fuller, Pontificia Universidad Catolica de Chile, Chile

Nowadays, the amount of scientific knowledge produced is overwhelming and it is clear that it will grow even more. Shaknoma (Shared Knowledge Manager) is a tool useful to make available and share the people's individual knowledge. The activities carried out on this tool respond to a model that ensure the input, validation, use and evolution of the knowledge. The process is implemented through four major components: the shared repository, the management model (see Herrera et al. 2000), the representation language of the knowledge, and the collaborative environment. The knowledge management model provides decision-making mechanisms, which mainly includes discussion and voting activities. As a way of structuring and graphic representation, Shaknoma uses a language based on conceptual maps (Novak 1984). The information repository does not store only knowledge, but also the information of its use and evolution.

Teachers and Computer Technology Training

David Hofmeister, Central Missouri State University, USA; Gerry Peterson, Central Missouri State University, USA

The poster session provides an overview of the processes and materials used to advance the integration of computer technology into student learning in K-12 schools.

Results and conclusions from a Learning Software Design Competition

Brad Hokanson, University Of Minnesota, USA; Simon Hooper, University Of Minnesota, USA; Paul Bernhardt, University Of Minneosta, USA

The University of Minnesota's Design Institute is sponsoring a competition to recognize the design of innovative educational software. The competition was open to professional and not-for-profit educational software designers in such areas as higher education, K-12 education and commercial training. Prizes will be given in each category, and entries for the competitions were due February 15, 2000. Winners of the competition were announced April 10, 2000. One of the competition's goals is to establish a bank of exemplary educational software that can be examined by designers and students of educational software design. To facilitate this goal, winning designs (and others selected for inclusion) will be compiled and made available to the public. We will present the results of the competition in a workshop format at ED-MEDIA 2000. The intended audience is educators and practitioners in the field of educational technology.

Constructive Hypertext for Learning

Hsi-chi Huang, The Ohio State University, USA

This study focuses on teachers as designers using constructive hypertext and teachers' perspectives on the use of the World Wide Web in educational contexts and its implications. Constructive hypertext encourages the participants not only to be users of hypertext, but also to be designers of hypertext. The study describes the participants' experiences as designers and their thoughts on designing hypertext for learning. In designing Web-based hypertext learning environments, educators can make use of the Web from three approaches: the Web as a resource for information, the Web as a medium of expression-representation, and the Web as a space for dialogue. The distribution perspective takes advantage of the Web as an information network. The expression-representation perspective uses the Web as a space for publishing, and expressing ideas and creativity. The Web as a space for dialogue has the capacity to encourage and embrace different voices. To participate in the dialogue is to create voices. The dialogue space provides possibilities for students to converse and exchange learning experiences.

Internet Infrastructure with ATM for Small Countries; Case Studies

Necdet ICIL, Eastern Mediterranean University, TURKIYE

Rapid development on communication technologies, become easy to support QoS (Quality of Services) application on Internet. As a case study, North Cyprus which is a small country with 5 small cities, develop a project to connect all cities with ATM BackBone. The purposes of the project is to connect all the local government offices to the cities node and to use all multimedia and information facilities on the BackBone. All governmental documentation will be send electronically between the offices. Virtual meeting will be possible by using video conferencing facilities. Also all schools will connect to the Ministry of Education to use educational facilities which are prepared by the trainers.

NACSIS-ILL Distance Training System in IDLE Distance Learning Project

Tomo'o Inoue, National Institute of Informatics, Japan; Haruki Ueno, National Institute of Informatics, Japan

We have started the distance learning project named IDLE (Integrated Distance Learning Environment) in 1998. The primary motivation of beginning the project is to meet the social needs. There are not many practical and sustainable DL systems in Japan, while on the other hand DL is already recognized as a natural form of getting education in the US. Current core product of IDLE is NACSIS-ILL Distance Training System, a WWW based system for training NACSIS-ILL operators. NACSIS-ILL is a system that our institute offers to nearly 700 university libraries to support exchange of information for the inter-library loan service. Our institute also offers NACSIS-ILL Training Courses to train the staff in the inter-library loan sections of the participating libraries. We have put emphasis on its practicality in the project and applied DL to the training course. The system will be in actual use this year.

Linking Active Learning to Web-based Instruction: Students Teaching Students through Multimedia Productions

James S. Javenkoski, Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, USA; Elizabeth F. Reutter, Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, USA; James E. Painter, Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, USA

Instructors (academic teachers and corporate trainers) recognize the value of video as an educational medium. Video provides learners (students and trainees) with opportunities to observe phenomenological examples that reinforce the concepts that are verbally described during classroom and laboratory sessions and on-the-job-training. Until recently, educational video production was a multi-step, multi-component process requiring at the minimum a camera or VCR, a computer (with a high speed processor, very large hard drive, and video editing and processing software installed), and a high speed serial I/O connection to transfer the video data between hardware devices. The new Apple© iMac™ DV desktop computer and iMovie™ software offer a simple, accessible, and affordable solution to instructors who wish to create continuous media (audio and video) for use in their courses. Our demonstration will showcase the QuickTime streaming videos produced in UIUC's FSHN 199: Business Etiquette and Protocol and FSHN 355: Fine Dining Management courses.

Using Tailored, Interactive Soap Operas for Breast Cancer Education of High-Risk Hispanic Women

Maria Jibaja, Baylor College of Medicine, USA; Paul Kingery, Hamilton Fish Institute, USA; Nancy Neff, Baylor College of Medicine, USA; Quentin Smith, Baylor College of Medicine, USA; Jennifer Bowman, USA; J. David Holcomb, USA

While Hispanic women have lower rates of breast cancer than other groups, among women from all ethnic groups, they are the least likely to undergo screening exams. This study evaluated a culturally sensitive and linguistically appropriate tailored computer-based educational program on breast cancer early detection aimed at high-risk Hispanic women. Spanish-speaking Hispanic women from an inner-city community health clinic were recruited and randomly assigned to either a computer intervention with an interactive soap-opera format (n=118) or a comparison group (n=60). True-false pre- and post-tests were used to identify any change in breast cancer related knowledge/beliefs. Both younger (18-40 y.o.) and older (41-65 y.o.) women in the intervention group increased significantly their knowledge/beliefs as compared to the younger and older women in the comparison group ($p<.05$). Computer-based tailored and interactive soap operas that are linguistically and culturally appropriate are effective in increasing breast cancer screening knowledge/beliefs in high-risk Spanish-speaking Hispanic women.

webStract - a Distributed Tool for Collaborative, Project-driven Learning on the Internet

Werner B. Joerg, NetEssence / U of Alberta, USA

webStract is a combined software tool that supports the construction and delivery of Internet based courseware. It embodies a project-driven paradigm - a problem based learning approach guided by the needs of student projects. It allows content providers to make effective use of the vast knowledge source of the World Wide Web and to present the students with qualified material in a structured manner. It takes advantage also of the interaction capabilities of the Internet, to enable focused synchronous and asynchronous communication among distributed teams and team members. Following a brief introduction of the motivation and the learning paradigm, our presentation centers on the three principal areas of service covered by webStract: knowledge qualification and structuring tools for the content provider, collaboration and management tools for the teams, and knowledge management tools for the individual student. webStract is currently being used in experimental courses. We'll report feedback from those experiments.

Digital Learning System: Web's Cool

Myunghee Kang, Ewha Womans University, Korea

Web's Cool (can also be pronounced Web School) program with SRL(Self-Regulated Learning) principles, PBL(Problem Based Learning) approaches and Keller's ARCS model for motivation has been designed by the author and developed by Samsung Electronics Company in Korea. Now, all the contents and study modules are completed in CD-ROM and the total service including Q&A and real tutorial help is now available on the UNITEL web service.

Learning Amidst A Sea Of Information In The New Millennium

Dan Kauwell, University of Illinois, Urbana-Champaign, USA; Jim Levin, University of Illinois, Urbana-Champaign, USA; Daniel Schiff, University of Illinois, Urbana-Champaign, USA; Young-Jin Lee, University of Illinois, Urbana-Champaign, USA

Visualization can improve our ability to access information and construct knowledge. Information visualization is particularly well suited for the location and analysis of information found on the Internet and, for the construction of knowledge from that information. Our research has led us to develop VisIT, a tool for the visualization of Internet based information and the analysis of that information. Instead of lengthy lists of search results, the user is presented with a graphical, spatial representation of the search space. Now the user can "see" the hits returned by the search engine as well as other pages from the same site. When any of the pages are clicked, the appropriate page is displayed in the browser window. Furthermore, VisIT facilitates the knowledge construction process by allowing its graphical displays to bc cdited, saved and re-opened later.

An@tomedia: A New Approach TO Medical Education Developments In Anatomy

David M. Kennedy, Monash University, Australia; Norm Eizenberg, The University of Melbourne, Australia; Chris Briggs, The University of Melbourne, Australia; Ivica Grkovic, The University of Melbourne, Australia; Priscilla Barker, The University of Melbourne, Australia

Evaluations have indicated that students find An@tomedia very engaging (Kennedy, Eizenberg, & Kennedy, In this volume). An@tomedia supports students actively in their learning tasks, fostering a deeper understanding of human structure, with a stronger basis for clinical diagnosis and procedures. The new medical course has focused less on traditional teaching, instead emphasising on focussed dissection, problem-based and self-directed learning. An@tomedia provides multiple perspectives of the human body. Each module is independent and of equal importance. The modules are:

1. Back,
2. Abdomen,
3. Thorax,
4. Neck,
5. Upper Limb,
6. Lower Limb,
7. Head, and
8. Pelvis.

The first 3 of the 8 modules, the Back, Abdomen, and Thorax have been completed, each organised into 4 major perspectives.

1. 'Dissection' includes practical (including emergency) procedures.
2. 'Imaging' incorporates sectional and endoscopic anatomy.
3. 'Regions' incorporates surface and functional anatomy.
4. 'Systems' incorporates conceptual and clinical anatomy.

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Offering Online Degree Programs: A Case Study Issues, Challenges, Successes, and Lessons Learned

Gerard Kickul, University of St. Francis, USA; Laurel Jeris, University of St. Francis, USA; Michael LaRocco, University of St. Francis, USA

Offering degree programs online offers an attractive option in the higher education environment. As schools confront this opportunity, familiar issues of quality, access, participation, retention, and assessment take on new meaning. Online delivery systems parallel traditional classrooms, including discussion and assignment areas, chat rooms, and online assessments. After experiencing high student dropout rates the University focused on several solutions to reduce its student dropout rate. These included online support systems with a centralized approach to addressing faculty and student technical concerns, complaints, and requests for assistance. A new assessment procedure consists of a two-phase process, a pre-course assessment and a more traditional assessment occurring during the final three weeks of the course. Finally, feedback from faculty on the various instructional design challenges including learning curve, time commitment, recommended class size, ethical issues, adaptability of subject matter content, and practical suggestions for reconceptualizing syllabi and assignments for online learning will be included.

Developing a Distance Education Infrastructure

Gerard Kickul, University of St. Francis, USA; Mark Snodgrass, University of St. Francis, USA

Development of distance learning infrastructure is a multifaceted project, from the desktop to the far reaches of the Internet. Attention must be focused on the outgoing data and information, as well as, incoming data and information. There are four basic areas of concern when designing an infrastructure to facilitate Internet distance education solutions: hardware, software, support, and security. Providing the proper hardware to developers and support personnel is crucial in creating a productive and efficient work environment. Reliable and efficient Internet access is essential, with 24-hour availability and minimal down time. Software components for development and support are key ingredients to success. From a student and faculty standpoint, the course software must be user friendly with a high degree of stability. Support must be considered from both a human and a technological standpoint. Essential to any online endeavor is secure access and distance learning demands the highest levels of security.

Content Management for Web Based Learning

Thomas Kleinberger, TECMATH AG, Germany; Paul Müller, University of Kaiserslautern, Germany

With the help of the newest information and communication technology all the needs of modern educational systems can be met for the first time in one tool: the computer. Computer based solutions provide the technological support necessary for the whole teaching and learning process. The greatest advantage of this tool is the possible combination of all its usable instruments, their flexibility and configurability. With new technologies and new media types it will be possible to support all kinds of training, self-study and continuing education. It is clear that these new methods and technologies require new methods and solutions for the tasks content creation, delivery and archiving. Especially the use of new media sets high requirements on these tasks. This article describes how content management systems, a technology already used in other kinds of business, can support these tasks in web based teaching and learning. A definition of content management is made and refined for the area of web based learning. The main building blocks and features of content management systems are described and the improvements for web based learning are highlighted.

Computer-Mediated Communication for Distance Education: Developing and Teaching a Second Language Course in Academic Reading

Esther Klein-Wohl, Open University of Israel, Israel

The Open University of Israel is searching for ways to improve its distance education methods. Taking advantage of the flexibility of computer-mediated communication (CMC), we will describe the application of CMC to academic reading. We chose e-mail support, which allows students to work on texts, and to receive feedback and help when needed. Reading - a mode of language use, and distance education - a mode of language instruction, feature striking parallels: the reader (in "real life") and the learner (when learning to read) each functions in isolation when interacting with a text. Discourse is enacted at a distance, a disassociated first person (the author or the instructor) is actively present, and no reciprocity is manifest, within the interactive context. Therefore, reading instruction and distance education seem very well-suited. Because CMC is particularly learner-centered, it seemed appropriate to adopt this more motivating medium of instruction to our traditional reading program.

The Major Promise of Distance Education Is On Campus

W. R. (Bill) Klemm, Texas A&M University, USA

Distance Education (DE) is reforming on-campus instruction. DE's impact extends beyond the mere use of technology to put more razzle-dazzle into classroom presentations and beyond the advantages of assisted learning via computer simulations, drills, and animations. DE should force teachers to re-examine teaching philosophies, style, and tactics. Distance Education shows that learning need not depend on classroom lecturing. Indeed, we should now re-consider the whole purpose of the classroom environment. DE prompts us to re-examine accrediting criteria of "contact hours" and "credit hours." Teachers, now freed from the lecturing straight-jacket, can explore creative ways to show students how to find, comprehend, manage, integrate, and apply information. DE reveals the value and need in teaching for more interpersonal communication, between teachers and students and among students. I see a revival of interest among teachers in group work. Specific strategies for this new kind of classroom teaching are illustrated in the poster.

Interactive Ophthalmic Pathology Tutor

Gordon K. Klintworth, Duke University Medical Center, USA; Anthony N. Benson, Duke University Medical Center, USA; Ann L. Bushyhead, Duke University Medical Center, USA

A CD-ROM interactive, instructional course on ophthalmic pathology and relevant anatomy with hundreds of high quality images has been developed for users with different knowledge backgrounds.

Cognitive Idea Processor --- Modified Mandal-Art

Kagemasa Kozuki, Konami Co, Japan; Atsushi Tsubokura, Osaka Electro Communiation Univ., Japan; Shogo Harima, Osaka Electro Communiation Univ., Japan; Noboru Ashida, Osaka Electro Communiation Univ., Japan; Katsuhide Tsushima, Osaka Electro Communiation Univ., Japan

The new idea processor called modified Mandal-Art which can assist a user in his associative thinking between given item have been developed in which a user can communicate with the system using eye movement , finger-hand motion and voice. A user of this idea processor is forced to associate by seeing only nine items on the matrix called Mandala on CRT at a time. We have measured this information retrieve behavior from item pool of our testee putting on eye mark recorder and data gloves. Human associative thinking in his problem solving is accelerated by using this cognitive idea processor. This type of idea processor may brings us innovation of educational style on the computer by using the student model which take account the real time associative behavior of a learner.

Dilemma of Inquiry and Reflection Through and With Technology: New Directions for Research in Post-Secondary Teaching

Olga Kritskaya, Michigan State University, USA; Tony Clay. Michigan State University, USA

The study explored the issues of pedagogy for teaching reflective inquiry in the undergraduate program in Educational Psychology. The analysis focused on the role of the learners' imagination and the use of instructional hyper-media texts in construction of meanings associated with the course content. Particular attention was paid to the development of student design ideas that they use for the arrangement of images, which reflect, as a special form of narrative, on their understanding of the disciplinary concepts, personalities and life experiences. The data illuminate the instructional conditions when the student's act of arranging information becomes an act of insight. The computer-based student projects (Teacher's Portfolio, Multi-Media Gallery), along with the instructional hyper-media texts, reveal a critical instructional shift in the pedagogy of teaching reflective thinking-from structure to process, from enforcing students' competence to engaging them into performance-that fosters a deeper understanding of the dialectics of socio-cultural processes.

Assessing and Training Admunct Faculty with Technology: Enhancing their Classroom Learning

Karen Krupar, Metropolitan State College of Denver, USA

Increasing numbers of adjunct faulty at all major institutions of higher education has made it imperative that institutions examine the technology competencies of this large contingent of faculty who now instruct 40% of the courses on the undergraduate level. Very little effort is being made to provide development or training for these faculty in technology applications that would keep their students current in the rapidly altering global world of the 21st century. Metropolitan State College of Denver reviewed their 650 adjunct faulty and found many interesting factors that will be reported during this poster session. It is evident that adjunct faculty need assistance in both learning specific technology programs and in applying the technology into their coursework.

Design an Enhanced Virtual Experiment Environment Using Science Process Skills on WWW

Li-Ping Kuo, Chung Yuan Christian University, Taiwan, R.O.C; Da-Xian Dong, Chung Yuan Christian University, Taiwan, R.O.C; Chang-Kai Hsu, Chung Yuan Christian University, Taiwan, R.O.C; Jia-Sheng Heh, Chung Yuan Christian University, Taiwan, R.O.C

This paper proposes a methodology of applying a proper distance learning system following Seven Steps of Problem Solving and Science Process Skills. To complete this process of distance learning, this paper also suggests some tools for student undergoing all the process needed in the problem solving. Virtual Experiment Environment and Experiment Record are presented for some new notions in this paper. In Virtual Experiment Environment, Visual Lab is a new idea to operate experiment in Internet and show the reality of experiment. Experiment Record solves the difficult of implementing sheet and chart in HTML document. An environment for teacher design Science Process Skills is also presented in this paper.

Analysis of messages on the Only One Earth Club; TV-based collaborative learning site on the Internet

Haruo Kurokami, Kanazawa University, Japan; Tatsuya Horita, Toyama University, Japan; Yuhei Yamauchi, Ibaraki University, Japan

Messages sent to our BBS for collaborative learning can be classified to 10 categories. Each of these categories has some types of interactions among participants and site-staffs. The types of interactions are promotion of in-depth learning, discussion, and question & answers.

Aged and Disability Care training: A CD-ROM based project

Mark Laidler, RMIT UNIVERSITY, Australia

This demonstration has been developed to highlight one solution for delivering high quality work-based training in a multimedia environment.

Civilization in the 21st Century

David F. Lancy, Utah State University, USA; David DeBry, Utah State University, USA; Megan Andrew-Hobbs, Utah State University, USA

We will report on the evolution of an on-line course. The Civilization/Humanities course had its origins in the reform of the university's General Education curriculum in 1994-95. It was one of several classes created to replace existing requirements. The reform effort was designed to create interdisciplinary classes that would put the emphasis on universal aspects of inquiry rather than the narrow focus of typical introductory classes. Other expected features of these new courses were an emphasis on writing and the integration of technology. The initial Civilization/Humanities class met these criteria and was, by several measures, quite successful. In developing his version of the class, Dr. Lancy digitized his very large slide library and students were thus able to more readily access the collection for study and review. Another milestone occurred in 1998 when the library adopted an Electronic Reserve policy. Forced to incorporate this system into his class, Lancy went further and adopted many of the built-in features of ERes" such as the "Bulletin Board." Civilization/ Humanities was moving towards the new millennium as it were. It became clear in the second year of implementing the new Gen Ed program (referred to as University Studies) that not enough faculty were signing on to teach the new courses. A bottleneck emerged which provided further incentives to adapt the few classes that had been developed to meet the new criteria for delivery to a larger audience. The most recent stage in this evolutionary process we will report on is the transformation of the Civilization course from a (primarily) classroom to (primarily) on-line delivery. In concluding we will generalize about this evolutionary process from cases gathered across the curriculum on our campus.

Wired for Learning

Donna Landin, West Virginia Deaprtment of Education, United States; Roberta Taylor, IBM, United States; Lynn Blaney, Wheeling Park High School, United States; Susan Alkire, Romney Junior HIgh School, United States

The Reinventing Education project was established under a $2 million dollar grant from IBM to the West Virginia Department of Education. Its purpose is to define and validate criteria for creating instructional plans that use the power of the Internet to address the West Virginia Instructional Goals and Objectives and improve student achievement and learning. A Criteria for Excellence was created, then employed by a group of pilot teachers to develop lesson plans that would be peer reviewed, validated by field testing, observed during classroom implementation, and repeatedly revised. The resulting lesson plans have resulted in significant learning improvement and have been placed in the Best Practices database and shared with all teachers in West Virginia. Instructional plans have been developed for K-12 classrooms in the areas of math, language arts, social studies and science by teams of teachers, pre-service teachers and college instructors. On line professional development facilitates implementation of the instructional-collaborative environment.

Redesigning An Individualized Paper-Based Course

Stéphane Lavoie, SOFAD, Canada; Jo-Ann Stanton, SOFAD, Canada

Web-based courses that are an adaptation of a paper-based version rarely take full advantage of the Internet and related technologies. Taking this into account, we developed a successful interactive web version of a French grammar course. This poster session will show how "Du français sans fautes" was reengineered to avoid the pitfalls of shovelware using an Oracle database created with Visual Basic applications. We will offer an insight into the most challenging aspect of the process: the development of interactive exercices. We will focus on how we worked around technical constraints in order to maintain our pedagogical goals. More than 1500 students have enrolled in the course since it went online in September 1998. You may access "Du français sans fautes" at http://www.dfsf.com.

Team-paced versus Self-paced: The Effects of Educational Game Design on Collaboration, Learning and Attitude towards Information Technology

Edith Law, University of British Columbia, Canada; Maria Klawe, University of British Columbia, Canada; Cristina Conati, University of British Columbia, Canada; John Meech, National Research Council, Canada

Avalanche is a multi-player game where players must cooperate to achieve a common goal. Using Avalanche, a pilot study was conducted to investigate (a) the effects of cooperative (team-paced) and independent (self-paced) learning on communication patterns, performance, learning and attitude of the players, and (b) whether there exists any gender differences in how boys and girls interact with the computer and their teammates in a cooperative gaming environment. 16 elementary school children, in same-gender groups of four, played Avalanche for two-hour sessions. Results suggest that although team-paced learning foster a positive, cooperative team dynamics, self-paced learning has a more significant effect on learning itself. In addition, boys and girls react to the two versions of the game differently. In particular, the self-paced female group demonstrates more cooperative and help seeking/giving behavior than the team-paced female group, while the reverse was observed among the boys.

Assured Quality Strategies in Web-based Accredited Programs

Judy Lee, University of Central Florida, USA

Distance learning poses a challenge to voluntary accreditation. Quality assurance in emerging technology mediated distance learning is a central issue for accredited programs. The Council for Higher Education Accreditation report (CHEA, 1998) defines "quality assurance" as the means by which the institutions or providers set their accredited programs goals and measure results against those goals in distance learning. Regional and specialized accrediting organizations are currently engaged in assuring quality in distance learning as part of their ongoing review of institutions and programs. "Distance learning is seen by many as transformative vehicle for increasing the pace of change and reform in higher education. For these and other reasons, analysis of quality assurance is an essential topic for national, state and institutional policy development (CHEA, 1998)." Areas of interest regarding Quality Assurance Strategies include course and program concerns and needs, faculty and student concerns and needs, technical needs, and administrative support.

Reference

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Training Students to Be Self-Learners in Educational Hypermedia and Technology Courses

Amy S. C. Leh, California State University San Bernardino, USA;

Modern technology is changing our education paradigm. Due to technology advancement, instructors can no longer play the role of "information-giver", rather have to become a facilitator. Facing tremendous amount of technology information, students in Educational Technology need to feel comfortable of learning technologies by themselves. The presenter employed a variety of instructional strategies in her graduate courses to train her students to be technology self-learners. In the courses, her students searched for Internet tools useful for instruction, selected computer applications that they would like to study, learned the selected tools in a team, and trained other class members the use of the tools they learned. In this poster session, the author will present teaching strategies, instructional activities, and course assignments that are related to the training. She will also report students' feedback on this kind of training.

Effective Use of Client-Server Software and Teaching Strategies in Online Courses

Amy S. C. Leh, California State University San Bernardino, USA; Laura Howzell Young, California State University San Bernardino, USA

In the field of education, many professors are incorporating online teaching into traditional courses. What is the impact? The authors received a university internal grant to convert two education courses—an instructional technology course and a course in adolescent development—to include online components. They report the benefits and challenges of using WebCT (course tools) with a variety of teaching methodologies. The poster session reflects results of a pre- and post- survey used in both courses to determine teacher attitudes toward online coursework. Students in both courses appreciated the flexible schedule of online work and time saved by not having to commute. The majority of teachers in both classes had not previously taken online courses; many liked the threaded group discussions and online testing, but a few who did not believe at the outset that on-line teaching is beneficial continued to reject it. For most of the participants, technology improved learning and achievement.

Stepnet: quality newspapers and web-based learning in the Netherlands

Jan Lepeltak, Meulenhoff Educatief, The Netherlands

Stepnet is a web-based newspaper-project in the Netherlands. Due to some educational reforms students in the upper grades of the Dutch secondary schools are to study partly individually, which implies that teachers are obliged to provide them with proper assignments. The results of these are part of the students' final examination. The use of ICT should also be part of their activities and a relation with daily (world-) news-events is strongly recommended. In order to facilitate the above aproach for teachers and students, PCM, a Dutch publishing company consisting of newspaper and educational publishing houses, developed a web-site. This site contains a D-base filled with assignments related to the contents of two daily national quality newspapers. Every three weeks during the annual schoolterm a special magazine is published. Schools will pay a fee and will receive a licence in return, which entitles all participating students and teachers to receive a copy of this magazine called the "@krant", as well as access to the assignment D-base and the @krant D-base containing the newspaper articles. In addition, teachers will receive a half a day on-the-job training about working with Stepnet.

Custom-Authored Hypermedia Exercises for Use in College Classrooms

Amy Lobben, Central Michigan University, USA

Continuously improving technology now allows educators new opportunities to move beyond traditional lecture style methods to create custom-authored multimedia, hypermedia, and animation presentations for use in classroom demonstrations or as computer-run student exercises. The development of new software programs and faster, more powerful computers, is beginning to change the creation process of dynamic presentations (multimedia, hypermedia, and animation). The once time consuming, programming intensive, and complicated methods of authoring such presentations have become manageable tasks through the use of improving computer programs, many of which are easy to learn and use. A series of computer-administered lessons have been created using Macromedia Director and Freehand. Each interactive lesson is designed to explain a specific topic and includes animation, graphics, photographs, quizzes, while maintaining stringent design guidelines. Applications such as these could have profound effects in large college classrooms, where traditional lecture-style approaches limit the individual, active learning by students.

Groupware Tools: Web File System Allows Students to Access Information Anywhere, Anytime

Tyrone Lobo, SiteScape, Inc., Canada

This poster/demo is based on SiteScape's Web File System and will explore how the Web File System allows users to securely store and manage large volumes of information entirely over the Web, giving students the freedom to access information from any industry-standard web browser.

A Web-based Hypermedia Pedagogical Course

Alla N. Makarova, St-Petersburg State Pedagogical Univeristy, Russia

The success of any hypermedia distance-learning course strongly depends on its psychological and pedagogical aspects. A study was made of the practical realization of some common pedagogical/psychological criteria in a Web-based hypermedia course. As a result of this study a template was developed which includes these criteria. This template may be included as a building block for many different hypermedia courses devoted to a particular subject. Some open problems with the template are discussed and analyzed.

Info Pursuits

Kerrie Manning, Leichhardt High School, Australia; Rosemary Ward, UTS, Australia; Tony Ward, Award Consulting Enterprises, Australia

Info Pursuits is an interactive CD-ROM game designed to teach and practice Library Information Skills. Students will answer Trivial Pursuits style questions and will be offered Information/Research Skills hints and suggestions as part of the feedback. These will include such things as techniques for finding resources, using encyclopaedias, dictionaries, non-print resources, Internet, statistical resources, telephone books, indexes, directories, interviews etc. Positive experience in using these resources may stimulate students to use them again in a different research task. The same skills are practiced many times with different resources and in different contexts, to facilitate transfer. The questions will be arranged in teaching area groups, to be used by teachers in ordinary lessons within the standard curriculum, or as extension work within standard curriculum areas. Many questions will practise general skills, but each curriculum area will provide experience with subject-specific resources.

Content Area Integration: A Step Toward Emiratisation

Reo H. McBride, Dubai Women's College, United Arab Emirates; Michael Ford, Dubai Women's College, United Arab Emirates; David Thomson, Dubai Women's College, United Arab Emirates; Raymond Yarsley, Dubai Women's College, United Arab Emirates; Laila Hawker, Dubai Women's College, United Arab Emirates

The Higher Colleges of Technology (HCT) is dedicated to the delivery of technical and professional programs of the highest quality to the citizens of the United Arab Emirates (U.A.E.). This is the goal of "Emiratisation": an affirmative action policy of employing nationals in larger numbers in the workforce, which is currently dominated by ex-patriot workers. The authors of this article state that the most effective way to better prepare our students in fulfilling their roles in the task of emiratisation, is to integrate the skills taught in English, Math and Basic Computing in the classroom, and NOT teach them as completely separate entities. In essence, integrating the skills taught in English, Math and Basic Computing develops in students greater linguistic abilities, technical skills, intellectual capacities, and leadership potential. This study describes efforts made toward accomplishing such a daunting yet absolutely necessary task for college students in the U.A.E.

High Tech Classrooms-Going The Distance with Distance Education

Patricia McNames, Indiana University Southeast, USA

The rapidly evolving paradigm of interactive distance education is changing the learning environment on and off campuses and schools nationwide. Educators are suddenly surrounded by not only the opportunities of distance education, but also by its demands. Thus, when educators begin using these boundary-spanning technologies to enhance the learning process, it does dramatically require teachers and students to change what they do. The purpose of this paper and poster/demo is to serve as a resource for educators who may be considering incorporating distance education approaches into their courses. In cyberspace, time and place are fourth dimensional. The four dimensions that will be discussed in this presentation are 1) defining the appropriate distance education system, 2) designing the interactive course, 3) developing a virtual learning community, and 4) dealing with technical difficulties.

An on-line introduction to quantitative methods

Moira McPherson, Lakehead University, Canada; William Montelpare, Lakehead University, Canada

This poster/demo describes the development, implementation, and evaluation of an "on-line" introduction to an undergraduate course in quantitative methods. The virtual curriculum modules developed for the course provided a forum in which information, knowledge, expertise, and questions could be explored and updated throughout the course. Working asynchronously, the user completed six assignments. Questions which arose during the user's session were passed to "experts" that provided feedback, electronically. The "question - feedback" loop was a dynamic component of the organizational structure and used different modes of communication, including e-mail, electronic conference rooms, bulletin boards, and on-line help pages. The assignments were submitted electronically to teaching assistants who evaluated the submissions and provided feedback directly to the users. The inclusion of direct feedback communication between experts and users reduced the impersonal characteristics that might arise within an asynchronous learning-environment.

Principles Of Cognitive Evaluation For An Educational CD-ROM For History

Christina Metaxaki-Kossionides, University of Thrace, Greece; Elevtheria Gonida, University of Thrace, Greece; Stavroula Lialiou, University of Athens, Greece; Georgios Kouroupetroglou, University of Athens, Greece

The evaluation of CD-ROMs and multimedia products used in educational environments ,is a major topic. One of the erasing problems is the formation of a set of pedagogical principles or concepts and their technological implementation. We present the formation of a set of cognitive principles. Those are included in the set of evaluation , concerning a CD-ROM developed by us. The topic was a history lesson about the Homer period. We have selected two types of principles which , together with the ones for software development, should form the set for the formative evaluation. The one sub - set included the pedagogical requirements for the lesson of history. The other sub - set included the principles delivered by the cognitive scientists. These last ones were developed for the specific topic. They mainly refer to the nature and processes of learning and instruction. The set of the cognitive requirements were added explicitly as fields for a database for software evaluation.

Authoring Multimedia, Designing Animations for Physics Education

Donald J. Metz, University of Winnipeg, Canada

Computer animations used in high school physics instruction are demonstrated. The programs are written using Asymetrix Multimedia Toolbook and are designed to address the specific needs of the students and their learning environment.

Dynamic Communication Layer Between Virtual Laboratory and Intelligent Agents

Kaufmann Meudja, UniversitT de Sherbrooke, Canada; Roger Nkambou, UniversitT de Sherbrooke, Canada

In the last few Years, virtual laboratory has become an important part in online courses. Some of those virtual labs involve intelligent behaviour. However, this intelligent behaviour is usually hard-coded in the virtual lab and therefore, limit the possibility of using reusable intelligent agents that are completely separate from the virtual lab and which can control most users actions in the virtual laboratory environment. We propose a way to separate intelligent behaviour from the virtual lab by the implementation of a communication layer between the virtual laboratory and intelligent learning agents.

Design, Delivery, and Evaluation of Online Courses: A Primer

Jerold Miller, United States International University, USA

Online learning environments can be highly interactive and student-centered. Incorporating the contributions and experiences of each member of a learning community into the coursework encourages students to contribute more of themselves to the course and allows them to learn more from their teachers and peers. Creation of functional online learning environments is contingent upon the effective design, delivery, and evaluation of online courses. This session will address the design of online courses and adaptation of traditional courses to the online delivery mode. Participants will understand appropriate online delivery methods, explore teacher-centered vs. student-centered learning, understand effective strategies for communication online, know how to adapt content and curriculum for online teaching, discover new assessment strategies for distance learning, and learn how to create an online community of learners.

Discovering xyAlgebra: Intelligent Interactive Internet Instruction

John Miller, The City College of CUNY, USA

Abstract: Passive activities such as watching presentations, listening to explanations of general principles and watching experts solve sample problems are helpful, but peripheral, to the mathematical learning process. For students the indispensable step is solving problems for themselves. Yet most commercial mathematics software still concentrates on presentations and sample problems, while sending students off line to do practice problems on paper without interactive support. Answers are either multiple choice or limited to a single simplified final step. Early Internet courses are even less interactive. In contrast, students using xyAlgebra can enter each step of each problem solution. They enjoy intelligent support at every step as xyAlgebra's suggested solution strategy changes in response to their steps in simplifying expressions, solving equations and even in setting up and solving verbal problems. The next version of xyAlgebra will support instruction over the Internet, yet the entire package can be downloaded without cost at math0.sci.ccny.cuny.edu/xyalgebra.

Problem-based Learning and Flash 4.0: An Experiment in Science Education

Leslie Miller, Rice University, USA; Janice Mayes, Rice University, USA; Donna Smith, Rice University, USA

How does one design learning resources that will reach large audiences, capture the imagination, and compete with the game environments that are popular among of middle school students? The Reconstructors is a new episodic adventure series, designed for the Web, with a substantive educational message. See http://reconstructors.rice.edu where a student enters a futuristic world in which he or she assumes the role of a "reconstructor." In the interactive mystery format, a student learns science and history relevant to the discovery and use of opiates. Over the course of four episodes or missions, students "solve the problem." The concepts of neurotransmission, the neurobiology underlying drug addiction, drug tolerance, and analgesia, as well as the history of opium use are presented.

On-Line Education Using Video Broadcasting Delivered from Perth Campus, Algonquin College

Maike Luiken Miller, Algonquin College, Canada; Dave Osborne, Algonquin College, Canada; Ian McCormick, Algonquin College, Canada

As part of the LCN (Lanark Communications Network) TAP project, Algonquin College at Perth Campus engaged in a video broadcast/conferencing pilot to deliver a course, "The History and Philosophy of Architectural Conservation" (ARC9001), simultaneously in 2 modes: lectures with electronic slides and traditional black board work and, in parallel, video broadcasts (IN@SEC VP Broadcaster) with e-mail feedback. This pilot demonstrated successfully that on-line co-delivery allows to teach students simultaneously at different locations employing video, audio and text via a network using relatively inexpensive broadcasting/conferencing software with minimal set-up requirements at the clients' site. Course delivery improved. Students enjoyed the choice of delivery modes to suit their learning styles. Professor appreciated more time for interacting with the students. Re-broadcasting at a later time possible. The delivery model - independent of the specific broadcasting tool - provides a means to reach remote connected students everywhere - be it rural or elsewhere around the world.

TLC : Teachers' And Learners' Collaborascope – A Platform For Analysing And Evaluating Online Education

Michelle Montgomery Masters, University of Glasgow, UK; Stewart Macneill, University of Glasgow, UK; Prof Malcolm Atkinson, University of Glasgow, UK

Millions is being spent on installing networks, computers and assembling distance learning material and ICT (information and communications technology) software. Yet the network technology is not being used to assemble databases which researchers, managers and politicians can "data mine" to guide their investment. In the TLC project we are pioneering techniques for assembling and querying educational data. Our goal is to initiate research into the best methods of rapidly assessing the effectiveness of resources deployed and then interpreting the data to improve our educational performance. We are not trying to reinvent the wheel and produce yet another online learning environment like WebCT or Virtual-U. Instead we are building tools which will work in collaboration with these existing learning environments and provide teachers and students with valuable information about the usage of their learning environment. The TLC project aims to utilise the emerging standards such as those from the IMS project.

The Third Dimension For World Of Knowledge: An Acceptable Way To Get In

Mikhail Morozov, Mari State Thechnical University, Russia; Aleksander Markov, Mari State Thechnical University, Russia

Educational CD-ROMs should be as interesting and attractive for children as computer games. The approach offered by the authors allows to reduce the existing gap between multimedia for education and for entertainment. It is achieved due to the unusual design of 3D interface and by using a special technique of development. As a general metaphor for organisation of multimedia environment the metaphor of theatre with all appropriate attributes was

chosen: the stage with visual educational content, side- scenes, a curtain, etc. For presentation of educational material in addition to traditional multimedia components, the new integrated forms are used. Because of complexity and richness of information of the CD-ROM model, its realization is based on graph of program transitions and application of script paradigm, which is accepted for the description of structure of the educational and navigating information. These solutions can be recommended for creation of a new generation of "three-dimensional" educational multimedia CD-ROMs.

Using a Web Site to Increase Student Motivation to Write and Enhance the Reading/Writing Relationship

Susan Nelson, Elm Street Elementary School, USA; Harrison Yang, State University of New York at Oswego, USA

This action research project is an example of how Internet technology is being used in an elementary classroom as a means to increase student achievement. The project explores the relationship between writing and reading and its affects on early literacy development. It also explores the concept of motivating students to write by publishing student work for real life audiences. The project uses the current technology of an Internet web site as a source for publishing student writing. It explores the effects that this type of publication has on student attitude, motivation to write, and literacy development.

TELSI, Web-Based Software For Collaborative Learning

Graciela Nielsen, Norwegian State Center for Adult Education, Norway; Boo Hever, Majornas Vuxengymnasium, Sweden; Aase Steinmetz, Undervisningsministerium, Denmark

The TELSI software has been developed with the support of the European Union under the SIMULAB-project. SIMULAB is a concept for Web-based collaborative tasks. TELSI has been created to cater for the needs of this type of activity, and is a flexible and user-friendly environment.

Development of Speech Input System for Web-based Courseware

Ryuichi Nisimura, Nara Institute of Science and Technology , Japan; Shoji Kajita, Nagoya University, Japan; Kazuya Takeda, Nagoya University, Japan; Fumitada Itakura, Nagoya University, Japan

We proposes WebSPEAC(Web SPEech Acquisition for Courseware) System that provides a speech-input function for Web-based online education system. WebSPEAC has the following three features; (1) easy to maintain the system by the use of a simple speech input program in Web browsers, while the other speech processing are performed on the Web server, (2) a natural interactivity between Web server and users by using the server push techonology, (3) a simple installation and no needs of external programs on client machines. To show the effectiveness, an Web-based speech analysis system, a speech recognition system and a student identification system are developed as the examples of WebSPEAC System. By using the speech analysis system, it is clarified that WebSPEAC System can significantly reduce task steps, error steps and elasped time for speech-input task, compared with the conventional method (file upload).

The Instructional Portal Project

Kevin Oliver, Virginia Tech, USA

The Instructional Portal is a clearinghouse of information, resources, tools, and services at Virginia Tech, designed to facilitate practical instructional design among faculty. Faculty can increasingly adopt and easily utilize educational technologies in their courses. While some faculty use technology to modify and improve teaching and learning practices, too many rely on tools to simply make their existing teaching practices more efficient. The portal is designed to help faculty integrate technology more effectively by applying three instructional design components. The analysis component outlines strategies and instruments to account for environmental and learner characteristics, and provides information about structuring course content. The strategy component describes instructional methods and models that utilize technology effectively, and provides teaching modules covering popular web-based instruction and interface design issues. The evaluation component describes evaluation methods and models and provides tools to help faculty revise and improve their technology innovations. Visit the portal at: http://www.edtech.vt.edu/edtech/portal/index.html

Integrating and Adapting Multimedia Resources

Mary Panko, UNITEC Institute of Technology, New Zealand

In UNITEC students enrolled on an Automotive Trades course have access to a series of 32 CDX disks, entitled The Automotive Trainee Series that provides them with a learning resource in addition to their basic theoretical and practical teaching. This study attempted to:

- discover what beneficial learning effects the students perceived as being currently provided by the multimedia component;
- examine the extent to which the tutors integrated and adapted the multimedia material as part of their teaching; and

- compare patterns of current disk utilization with those of the previous year.

Results showed that although both staff and students thought the multimedia material valuable, its overall utilization by students had diminished over time. The reason for this appears to be the lack of integration of the resource by tutors into their teaching. Furthermore, tutors had generally not adapted the material for their own needs although where workbooks had been provided, this seemed to increase the students' satisfaction.

DISCETECH-BIMBOTECH: An Experimental Project For Introducing Innovative Technology Within The Italian School System

Paolo Paolini, Politecnico di Milano, Italy; Pierluigi Della Vigna, Politecnico di Milano, Italy; Francesca Collina, Politecnico di Milano, Italy; Paolo Magatti, Politecnico di Milano, Italy; Silvia Moiola, Politecnico di Milano, Italy

Since 1996 Politecnico di Milano has launched a program for experimenting, within the Italian school system, the use of advanced technology for teaching and learning. Two projects (in Como and Lecce) have involved more than 700 teachers and more than 8.000 pupils, being the largest of this kind in Italy, both in High Schools (Discetech project) and grammar schools (Bimbotech). The project emphasizes the role of the teachers, who are trained on multimedia and Internet technology first. Secondly they are "guided" and assisted in shaping up specific activities with usage of either multimedia CD-ROM's or Internet Sites. A large collection of CD-ROM's has been created and several hundreds educational Websites, on different subjects, have been classified. The project has been very successful with the teachers (many of them have never used advanced technology before) and the pupils, the learning and the interest of which has been evaluated as sharply improved.

Learning Experiences in New Learning Environments

Heli Pekkala, University of Jyvaskyla, Finland

One of the outcomes of a departmental action research project at our language centre is a modernised Learning Centre, where students and staff of the university have access to learning materials in over 30 languages. The philosophy and pedagogical framework underlying the operations of the centre is to support and encourage students in developing their learning skills and self-directiveness for continuous language learning and for making effective use of new learning environments . This poster presents the Learning Centre (interactive studios, writing studio, multimedia studio etc.) and reports student experiences of learning a new language independently. One part of this learner training course Learning to Learn Languages was a self-access project during which students were requested to reflect upon the kinds of qualities and procedures that self-directed language learning requires from a learner. They also evaluated what areas of language were possible to access without external structuring and teaching.

Microsoft Office as a Learning and Teaching Tool

Craig Place, Acadia University, Canada; Michael Shaw, Acadia University, Canada

Many useful features in popular software applications often go unnoticed by many users. Often thought of as a business application, Microsoft Office is one such suite of applications that is often overlooked as a tool for use in the teaching and learning environment at most grades, and at the university and college level. With just Word, Excel and PowerPoint, MS Office can be used as a tool to develop the basic understanding and expertise for a number of other applications including photo-editors, drawing and animation programs, multimedia authoring and web-development tools. Used as a stepping stone to more advanced applications in this way, the interface of each of these 3 applications can be simplified to be useful at a number of different grade levels, or levels of expertise. Using a combination of examples and hands-on exercises the workshop will illustrate to the participants how MS Office can be used to easily and effectively create multimedia hyper-documents, dynamic learning-objects, student review exercises and interactive non-linear presentations. Specific examples will be the use of PowerPoint as a concept-mapping tool and as a multimedia authoring and animation tool. Using Excel to assist in language learning and create dynamic graphs for interactive what-if scenarios, and using Word to develop hypermedia templates and collaborative writing documents. Several examples of the usefulness and creation of macros will also be shown.

Students' expectations and perceptions of efficacy for self-regulated learning in mediated learning environments: Partial results of an evaluation

Laura Helena Porras, Universidad de las Americas, Puebla, Mexico

This paper discusses partial results of an evaluation applied to an educational teleconferencing system in a Mexican higher-education institution. Courses offered through the system are based on a pedagogical model, which emphasizes the active role of the learner as responsible of her own learning. Therefore, perceptions of the self, and self-regulatory processes become key components in this learning environment. Conclusions here presented correspond only to: (i) students' expectancies, (ii) perceptions of efficacy for self-regulated learning, and perceptions of the course, and of the teacher and learner's work. Results indicate students' expectancies focus on "learning more than in face-to face situations", followed by "using technology", and "having freedom and initiative". Perceptions of efficacy for self-regulated learning were high overall. Nevertheless, analyses of individual items identify specific areas of improvement. Qualitative data on perceptions of the course, and teacher's and learner's work suggest that these courses are more demanding than the face-to-face ones they are taking. Students' responses include attitudinal and cognitive adjustments needed for these learning environments. These results have led to improvements, which are presently being applied.

An Online Model For Precalculus

Hari Pulapaka, Valdosta State University, USA; Denise Reid, Valdosta State University, USA

Some of the greatest challenges to designing and delivering a completely online mathematics course are effective and efficient uses of the leading technologies that are available for this purpose. The authors have just completed designing the first version of a precalculus course that is being delivered through a combination of synchronous and asynchronous environments. Precalculus was chosen over other mathematics courses for several reasons. The course has been planned as a model online course for any mathematics course (especially at the early levels). Future versions of this course and related courses will undoubtedly incorporate additional technologies and components in an effort to improve student learning, interactivity, and end-user feasibility. Future plans for the course include development and refeinement of the unfinished sections of the course and tighter integration with graphing calculator and/or mathematical software.

IMAGUS: An Environment To Design Video Applications For Digital Libraries

Andre Luis Alice Raabe, Pontificia Universidade Catolica do Rio Grande do Sul, Brasil; Lucia Maria Martins Giraffa, Pontificia Universidade Catolica do Rio Grande do Sul, Brasil

This poster presents the description of the IMAGUS environment. IMAGUS has tools to built video applications supported by Internet. This environment has being developed in order to contribute for the construction of the PUCRS digital library collection.

Art, Poetry, and Instructional Media

Thomas Reinartz, Rosemount High School, USA; Brad Hokanson, University of Minnesota, USA

In many high school English courses, students are trained to seek out proper form and work toward clarity in their writing assignments. They are taught to write using complete sentences and complete thoughts, fix their punctuation and grammar, and strive for polish in all written work. That is what English is all about. On one level, we can be pleased with their concern. However, this quest for excellence and perfection seems to interfere with the poetry writing process. Many successful poems lack complete sentences, defy traditional uses of punctuation, and contain word combinations that require readers to make inferential connections, often sacrificing the writing clarity that English teachers work so hard teach. We have taught them to be concise, clear, and correct in all writing endeavors, which in most cases, is sound advice. Writing poetry, however, demands skills that require us to play with words and dwell in areas where word juxtapositions and combinations are limited only by one's imagination. The many choices in this "zone" of possibility are frighteningly endless, so it is no wonder students resist entering. They may get lost. To help foster an awareness about word choice and imagery, we developed an interactive program to generate "found" poetry with student input and used it in a twelve week American literature class taught by T. J. Reinartz, one of the authors. The program evolved from discussion between the authors regarding the use of computers to inspire poetry writing. A multi modal qualitative research study was undertaken involving classroom observation, video taping, survey questions and analysis of poetry segments. The findings of that research and analysis will be presented, with broader observations of the use of computers 'in the service' of poetry, and their appropriate use in the high school classroom.

Students as Producers: Changing the Way we Teach and Learn

Gail Ring, University of Florida, USA; Sebastian Foti, University of Florida, USA; Melissa McCallister, University of Florida, USA; Tamara Pearson, University of Florida, USA; Ebraheem Alkazeemi, University of Florida, USA

Educational technology courses at the University of Florida are modeling the concept of students as producers. Through student-based projects such as an online support center, educational software, student portfolios, and documentary-type CD-roms our students are producing educational products. These 'real' activities are improving our courses as students learn by doing, thereby creating a constructivist learning environment. Relevant, contextual projects such as these provide students with an increased sense of empowerment and ownership. In our presentation we will share how the traditional roles of instructor and learner may no longer appropriate.

The GPB project; A successful PHD seminar using Videoconference in real time and a list to communicatebetween the classes

Claire Roberge, University of Quebec in Montreal, Canada

This winter 2000, a seminar was offered at the PHD level in the departement of Communication at the University of Québec in Montréal.Three teachers participated, one from Montréal, one from Paris and one from Grenoble. Seven sessions were offered in videoconference to all students enrolled. A website and a list were added tools offered to the students to communicate between the sessions. The sessions in videoconference were in real time.

Teachers and students made presentations and periods of questions were planned at the end of each of those presentations.The experience which will be renewed next winter was a success. Technology was used wisely, the teachers made sure the environment available enhance the learning process of their students.The differences in cultural habitus and in the uses of technology were taken in consideration.An evaluation was made taking seriously all factors.

Multimedia Training , Virtual Instrumentation and Remote Laboratory a New Approach to the Electronic Courseware

Nicoletta Sala, Academy of arch. University of Italian Switzerland, Switzerland

This work describes a project developed at the Department of Electronic Politecnico of Torino in the field of multimedia technologies in educational process. The goal was to allow the students to carry out a pre-training activity outside the laboratory and possibly at home; each student could thus individually adequate the learning rate to his own capabilities. After this pre-training phase, students who enter the laboratory require reduced assistance and less time to complete the training activity. This approach can reduce the qualified assistance that is not easily found. For this reason several hypermedia mod-ules have been developed (using Multimedia Toolbook) to assist the students to acquire the fundamentals of the basic electronic instrumentation. The subjects developed are:

- fundamentals of the analog and digital oscilloscope, which includes practical exercises;
- fundamentals of the analog and digital voltmeters and their operating theory;
- the IEEE488 standard interface for programmable instrumentation;
- the logic analyzer;
- the spectrum analyzer.

Virtual instruments are implemented in order to allow simple simulations of the real instruments during the self-training phase A client-server system has been designed in order to allow the students to operate on a remote laboratory for experimental training. The idea is to design a laboratory that is simultaneously and remotely accessible to several students, who concurrently share the same instrumentation, but not necessarily the same experiment. The instrumentation and the other hardware resources are accessible in a sort of time sharing process, which is managed by a server and transparent to the user. The virtual laboratory architecture is composed of two kinds of subsystems: the measurement Server and the measurement clients.

Strategies for Teaching and Learning: Lessons Gained from an Ethnography of Graduate Classes in an Interactive Distance Learning Studio

Lorraine C. Schmertzing, University of West Florida, USA; Richard W. Schmertzing, Valdosta State University, USA

This poster session is based on data collected during a one-year ethnographic case study of graduate education classes during the inaugural year of a 2-way audio/2-way video interactive distance learning classroom at a regional university in the southern United States. Cultural anthropology and symbolic interactionism acted as guide to uncover and describe the processes through which adult learners transformed traditional classroom culture as they implicitly redefined that culture during their initial exposure to a specific distance learning environment. This poster session addresses the often un-addressed complexities inherent in re-defining ones learning environment so that effective learning can occur and offers strategies for teaching and learning based on these complexities. Strategies include ideas for the first night of class, cultural awareness activities, feedback forums, and rules of engagement.

Use of Telecommunications Technology in Radiation Accident Simulation

Domenic Screnci, Boston University School of Medicine, USA; Kirsten Levy, Boston University School of Medicine, USA; Erwin Hirsch, Boston University School of Medicine, USA; Richard Aghababian, University of Massachusetts Medical School, USA; Tracey Russo, Boston University School of Medicine, USA

Radiation accidents are rare but increasing in frequency. Partners in a regional project are providing training on radiation accident preparedness in Eastern Europe and the New Independent States. Recently, the partners devised a radiation accident exercise to simulate radiation exposure and test inter-regional cooperation among eight nations. A variety of multimedia, communication and distance learning technologies was used to execute the exercise. This poster describes:

- Objectives
- Design
- Procedures
- Communication Plan
- Educational Technologies

The exercise demonstrates a live response to a simulated radiation accident; the ability to exchange information among peers, request resources and notify appropriate agencies; and the use of communication technologies to debrief the experience. Also demonstrated is the use of distance learning technology to cultivate regional harmonization of response in a field in which preparedness is essential but practical exercises lacking.

Teaching data analysis using thin client technology for remote access

Robert Seidman, San Diego State University, USA; K. Michael Peddecord, San Diego State University, USA

This poster describes implementation and outcomes of using thin client technology to provide remote access in a data analysis course. All software applications run on the course server, so no downloading of data or software is required. Results from statistical analyses are transmitted to students' client machines. Students were able to launch applications and complete assignments from any location that had Internet access. In addition to 7/24 access, students were able to use software they did not own and large data files they did not have on their own computers. While they generally expressed satisfaction with this remote access capability, drawbacks included initial programming time and cost of the server software, lack of familiarity with operating in a networked environment, frustration with server-side disconnects or ISP interruptions, and occasional inability to print at home because the server software does not include all old printer drivers.

Multimedia Guide to Fractal Geometry

Vladimir Shlyk, Belarusian State Pedagogical University, Belarus

Fractal geometry has changed our view of natural processes and geometric forms. The Guide is a software kit supporting a university course on this science. It contains an introductory electronic textbook, annotated list of publications, favorite Internet links and provides facilities to run programs. One program of the project visualizes the mechanism of birth of classical and IFS fractals. A student can grow fractals by himself and explore their features by trying different generators and mappings. Another program demonstrates connection between the Mandelbrot and Julia sets. It throws a bridge from fractal geometry to nonlinear dynamics and chaos theory by showing different variants of behaviour inherent in underlying quadratic process. Having advantages over analogous programs, it is already being used at several universities. To create the most complete educational software on fractal geometry we would be pleased to collaborate with other specialists and enthusiasts.

Project-Based Learning + Multimedia: Adding Value to Students' Education

Michael Simkins, Silicon Valley Network, USA; William R. Penuel, SRI International, USA

"Does technology really make a difference in student learning?" Definitely, according to the Challenge 2000 Multimedia Project, one of the original Technology Innovation Challenge Grants funded by the U.S. Department of Education. The Project has demonstrated significant educational results when technology investment includes teacher training, technical support staffing, and curriculum materials development. In a five-year evaluation of the $6.2 million project in California's Silicon Valley, SRI evaluators found that technology-using students surpassed their non-technology-using peers in developing some of the most critical skills for the new economy of the 21st century. These skill advantages included better communication, teamwork and problem-solving. Researchers also found important positive changes in teachers classroom practices that support a constructivist approach to learning. In addition, these same students equaled their non-technology-using peers in learning the basic skills measured in standardized tests. In short, students in technology-using classes not only "got the basics," they got more.

The Search for the Skunk Ape: An Information Literacy WebQuest

Charlotte Slater, The Walden Institute, USA; Pamela Sawallis, Florida Gulf Coast University, USA

A web-based instructional resource for distance and on-campus learners uses elements of goal based scenarios (Schank, 1994) and WebQuests (Dodge, 1997) to provide a "fun," story-based environment for learning information literacy skills. This project represents a partnership between instructional technology and library services at a state university.

Online Learning in a 3-D Robotics Workshop: The NASA ROVer Ranch

Stephanie Smith, NASA/LinCom, USA

The ROVer Ranch is an online environment based on NASA's mission as it relates to robotics engineering. Students are situated where they learn about robots and then build and run simulated robots in a 3-D virtual world. The robotics workshop has all the components to build a "soft" version of a robot and the tools needed to instruct the robot to complete its mission. Student engineers or teams select a mission, review the mission goals then design a robot with the appropriate attributes (power source, navigation planning, tools, etc.) based on the mission objectives. Once the robot is constructed, students plan a navigation path and then place the robot in the simulation to execute the mission. This simplified design and programming exercise is an interactive method to learn science and math skills both individually and in a team setting as students share their experience in journals and team message boards.

OATS: Operational Amplifier Tutorial Simulation; a dynamic presentation

Sarah Sniderman, Concordia University, Canada; Gary Boyd, Concordia University, Canada; Geza Joos, Concordia University, Canada

Abstract: Operational Amplifiers are among the most important components used in analog electronic devices. They are complex and initially counter-intuitive in behaviour. Electrical engineering and electrotechnology students frequently need special tutorial help to understand them and configure them to work properly in various circuits. The main advantage of simulation programs for higher education in technical fields is that, when carefully designed, they can promote higher level instructional goals of prime meta-cognitive value, especially those involving the autonomous active construction and exploration of knowledge at a pace appropriate for the learners. Note, however, that such free exploration of knowledge at a responsive pace is not a quality inherent in multimedia instruction. High-level interactivity involves more than guided clicking through branched instruction. A truer understanding requires a learning environment which accommodates the testing, falsifying, validating, and elaboration of understandings.

The Munchhausen-Trick: Learning Internet by Internet

Ralph Sontag, TU Chemnitz, Germany; Dietrich Thie, TU Chemnitz, Germany

The Chemnitz University of Technology is the first one in Germany, which is able to offer an internet-based study about information and communication technology. The participants of the courses are able to collect fundamental and applicable knowledge about internet-related technologies using it - a problem comparable to the baron of Munchhausen, which drags himself at his tuft out of a marsh. After two introducing lessons the communication between learners and teachers is stricly internet-based. Stepwise the students are qualified to understand and maintain complex situations in management of ip-networks and servers. The knowledge can be proofed in a remote managed, but actually existing laboratory. Moreover we had to consider the very heterogenous working times of our participants. We prefer asynchronous communication with short turn-around-times in conjunction with online-tools like "virtual seminars", tests or experiments. The consequently platform-independent project uses open protocols and standardized document formats like HTML or XML.

In defence of 'shovelware': A powerful tool in staff development for online teaching and learning

Heather Sparrow, Edith Cowen University, Australia; Jan Herrington, Edith Cowen University, Australia; Tony Herrington, Edith Cowen University, Australia

A significant challenge for universities creating effective online learning environments is educating and empowering teaching staff. Those who are not confident using technology are frequently unconvinced about the benefits and are concerned that it will force unwanted changes on their current practices. This poster outlines a project which introduced a large number of variously experienced academic staff to online teaching, whilst maintaining or enhancing effective learning. The project included the simple conversion of print-based external units to an online mode, as one of several strategies of development. Whilst this process is often referred to derogatively as shovelware, some of the positive and immediate outcomes achieved will be described, and challenges will be made to extremely negative attitudes towards such conversions.

An Evaluation of Video Compression Schemes for Teleteaching Applications

Ognjen Stanovcic, Open Systems AG Zurich, Switzerland; Thomas Walter, Swiss Federal Institute of Technology Zurich, Switzerland; Bernhard Plattner, Swiss Federal Institute of Technology Zurich, Switzerland

Synchronous, interactive teleteaching is demanding with respect to required network bandwidth and short end-to-end delays. An uncompressed digital video, e.g., requires a data rate of 261 MBit/s. Video compression is a method to reduce required network bandwidth. Efficient video compression is almost lossless with respect to perceived video quality at the receiving site, but it is time intensive. In support of interactivity, however, response times must be short to allow participants to audio-visually communicate like being in the same room. This implies that the end-to-end communication delay should be less than 150 ms. This requirement puts a hard constraint on video compression since compression time is only one factor that adds to the overall end-to-end delay. We present a framework for the evaluation of video compression schemes. We define evaluation criteria such as compression delay and compression efficiency. The video compression schemes evaluated are Motion JPEG, MPEG, H.261 and H.263.

Multibook: making web based learning resources personal

Achim Steinacker, TU Darmstadt, Germany; Cornelia Seeberg, GMD IPSi, Germany; Ralf Steinmetz, GMD IPSI, Germany

Considering the amount of knowledge accumulated on the Web, the discussion of an effective use of the web resources becomes urgent. The main question is how to find the relevant information . In our web based teaching system Multibook we use modularized learning content stored in a knowledge base and describe these modules such that the combination of modules can be matched to the users preferences, represented in a user profile. In this demo we will show our knowledge base containing both the actual multimedia learning resource and the metadata in form of a terminological ontology, attributes for the resources and relations between the resources. Then we sketch the user profile and finally we show how these components are matched together

Math and Science Curriculum Revision: A Collaborative Approach to Improving Preservice Teachers' Use of Technology Knowledge and Instructional Skills.

David Stokes, Westminster College, USA; Carolyn Jenkins, Westminster College, USA; Lorel Huhnke, Westminster College, USA; Gothard Grey, Westminster College, USA; Cheryl Manning, Bryant Intermediate School, USA

Reports on a Preparing Tomorrow's Teachers to use Technology Capacity Grant project, a consortium comprising Bryant Intermediate School, and Westminster College, both of Salt Lake City, Utah. The consortium participants engaged in collaborative curriculum development to provide preservice teachers greater exposure to the instructional uses of technology in education. Skills in the application of communication, presentations, and CLE technologies were explored. Teaching units integrating sound curriculum with technologies including: video-microscopes, CBL probes, graphing calculators, Excell, PowerPoint, various software programs, and the Internet were developed. Outcomes suggest improved teaching with technology skills, better real-world collaborative inquiry, greater focus upon multiple learning styles; and gains in extending the power of scientific inquiry into mathematical and scientific reasoning.

Integrating pedagogy, content and technology into your curriculum

David Stokes, Westminster College, USA; Wanda Carrasquillo-Gomez, Westminster College, USA

Perhaps there are fewer more daunting tasks to teacher educators than to find the time, means, and information to begin to more fully integrate technology as an instructional and learning tool into their courses. Over the past year the authors conducted a thorough curricular revision of technology courses offered in the Master of Education program at Westminster College in Salt Lake City. Courses were redesigned focusing curriculum upon technology as a communication rather than a presentation medium. Outcomes suggest this approach is beneficial to generating increased understanding of the role technology can play in teaching and learning, and in strengthening key linkages between constructivist theory and teaching practice.

SMILE Maker - An Intelligent Learning Environment for Problem Solving

Svetoslav Stoyanov, University of Twente, The Netherlands

This poster introduces SMILE Maker - a web-based tool supporting ill-structured problem solving activities of students involved in problem-based learning. SMILE Maker stands for Solution, Mapping, Intelligent Learning Environment. It is both a problem solving and a learning tool. As a problem solving tool it proposes a method for creative problem solving based on the synergy of some mapping approaches like concept mapping, mind mapping, cognitive mapping, flowscapping, and process mapping, and a systematic creative problem solving methodology. The method facilitates elicitation of tacit knowledge, an effective organization of the explicit knowledge, and avoidance of some negative individual problem solving syndromes like analysis-paralysis, functional fixedness, premature judgment, and etc. As a learning method it provides an individualized learning environment for studying and applying this method. It adapts learning to four personal constructs such as learning styles, problem solving styles, learning locus of control and prior knowledge.

An Adaptive Web-based Course in Financial Engineering with Dynamic Assessment

Alberto Suárez, Universidad Autónoma de Madrid, Spain; Estrella Pulido, Universidad Autónoma de Madrid, Spain; Rosa Carro, Universidad Autónoma de Madrid, Spain

The increasing relevance of interdisciplinary skills calls for the design and implementation of novel strategies to address the problem of teaching a corpus of knowledge to a heterogeneous audience. We have chosen a problem in financial engineering, the valuation of European options, whose mastery requires the interplay of mathematical, computational and financial tools. The target audience in financial engineering courses is generally composed students of either financial background or from a scientific, non-financial area (mathematics, computer science, physics). The course is designed within the framework of the TANGOW system (http://www.ii.uam.es/esp/investigacion/tangow/present.html), which provides the necessary mechanisms to construct a web-based course whose contents are dynamically generated according to the student's profile and actions. The system includes the possibility of dynamic assessment, which involves testing not only the student's ability to understand static knowledge, but also his/her ability to actively design procedures (programming analytical formulas, realization of simulations) to achieve the prescribed goal.

Building Learner and Teacher Autonomy for New Learning Environments

Leena Subra, University of Jyvaskyla, Finland; Liisa Kallio, University of Jyvaskyla, Finland; Ulla Lautiainen, University of Jyvaskyla, Finland

The poster reports on the experiences of our departmental action research project aiming to explore the use of ICT-enhanced methods in promoting both learner and teacher autonomy/self-directedness in discipline-based language learning and instruction. The action research approach involves continuous staff development, needs identification and aims-setting, teacher and learner self-assessment, learner training, and development of a variety of learning tasks suitable for self-directed learning in both authentic and virtual learning environments. It also involves an attempt of creating a set of ICT-enhanced course formats which - without significant, time-consuming and technically demanding modifications - could be used in teaching and learning languages. The poster describes pilot courses which use different approaches, materials and programmes, and are aimed at different kinds of learners. They cover a variety of possibilities and combinations but remain within the same pedagogical framework, since learner and teacher autonomy are the basic guidelines in all the pilot courses.

Development of a Computer Aided Cooperative Classroom Environment

Akira Suganuma, Kyushu University, Japan; Ryunosuke Fujimoto, Kyushu University, Japan; Yutaka Tsutsumi, Kumamoto Gakuen University, Japan

In the educational domain, a popularization of computers and the Internet enable us to hold lectures using Web contents as a teaching material. We propose CACCE, Computer Aided Cooperative Classroom Environment, which is an WWW-based supporting system for a classroom teaching. CACCE consists of a server-software and a client-software, that is to say, a teacher's browser and a student's browser. These browsers are connected together by a socket connection, sends and receives some messages such as a URL and the CACCE's command. There are three main features of CACCE. First, CACCE automatically refreshes student's browsers. Secondly, CACCE displays a cooperated mark and text on these browsers. Finally, student's browsers automatically report an URL of page shown by them to teacher's browser. This information is used as one of the guidelines for teaching. It is concluded that CACCE is not only a tool that broadcasts the document on a teacher's browser to students, but also a cooperative environment.

Using Knowledge Models in Intelligent Tutoring Systems

Stephen G. Taylor, Champlain Regional College, Canada

The Virtual Tutee system will be introduced as a prototype of an intelligent tutoring system. The user of this system adopts the role of the tutor and studies photosynthesis by tutoring a virtual tutee residing within the software. The system was produced as a simulation based on a model of the tutoring learning situation called the Knowledge Modelling Approach, which will also be introduced. Fifty college students participated in a test of the system.

An Evaluation of Interactive Studio Physics I

Holly Traver, Rensselaer Polytechnic Institute, USA; Michael Kalsher, Rensselaer Polytechnic Institute, USA; Karen Cummings, Rensselaer Polytechnic Institute, USA; Keith Hmieleski, Rensselaer Polytechnic Institute, USA

Rensselaer Polytechnic Institute has implemented an innovative physics course ("Studio Physics") that promotes collaborative interaction. Students work in groups of 2-4 on computers connected to the local network and Internet. Class time is spent on short lecture and group exercises. This research study evaluated Studio Physics in terms of grades and alumni responses. An examination of course grades from students who took the first courses of Studio Physics yielded no significant difference between traditional lecture and studio courses. However, as the studio course has evolved, learning has improved. Alumni were contacted and asked for their opinions on all types of courses, including studio. Alumni indicated working collaboratively with others helped them to improve communication, interpersonal, and computer skills, as well as the abilities to work with others, learn new material, and perform at their current job. This finding is important for work organizations, since much of work today is group-based.

Grasp of Few body element's correlative operation using Multi points measure data-Compair with 2 kind selection-

Atsushi Tsubokura, Osaka Electro-Communiation Univ., Japan; Kiyoshi Masui, Osaka Electro-Communication Univ., Japan; Noboru Ashida, Osaka Electro-Communication Univ., Japan; Kagemasa Kozuki, Konami Co., Japan; Katsuhide Tsushima, Osaka Electro-Communication Univ., Japan

Expert Operator has any skill for machine operation.But novice has a little skill.The novice do and error operate when try need to new operation skill.Our target is to trace the Operator's skill learning process and the task identificate for the skill learned.The newer operation skill based another already learned operation skill.These Operator's skil was changing during Try Operating.The changed operation can show operation timming and used skill for operation. We used few body's measure data and identificate his operation using symbolic way.Measure device is Eye Mark Recorder,3D position or degress sencer(for Arm Motion),Data Grove.This paper propose the symbolic way for Multi Points Measure data's correlation and single measure data's characteristic, and evaluate the measure data using these way.This paper is introduction of these reserch.

Offline projects for cross-cultural competence improvement

Victoria Tuzlukova, Rostov State Pedagogical University, Russia; Irina Rozina, Rostov State Pedagogical University, Russia; Cyndy Woods, Arizona state University, USA

Russian and U.S faculty members from the Department of Foreign Languages, Rostov State Pedagogical University - RSPU, Russia and Arizona State University, Phoenix, USA, developed off-line writing projects designed to increase language proficiency, cross-cultural awareness, computer and networking skills. Targeting EFL students (English as a Foreign Language), the project has demonstrated that students not only increase English language proficiency, but students learn more about the way of life, basic values, and cultural background of the people, whose language they study.

Analyzing Artists' Interaction with an Artificial Reality

Elpida Tzafestas, National Technical University of Athens, Greece

Our long term goal is to understand how humans build models of biological phenomena. To this end, we are studying the relation between an artificial reality and the model of it that an observer deduces. The study is currently based on the observation of how Digital Art students interact with "PainterAnts", an educational simulation software that is used for laboratory work on intelligent and complex systems. The software is a special-purpose ant population demo that tries to convey and teach regulation principles using graphical means. Artists have shown a high motivation to experiment with the system, partly because they tend to regard it as a simple abstract art tool. They manage to create a functional model of complexity, without really understanding the underlying models. Few experiments with users of different background, have shown that humans, independently of background knowledge, tend to find complex top-down explanations to apparently complex phenomena.

Supporting Virtual Classrooms through Extranet technology: the Eurydices system

Kostas Bovilas, University of Patras, Greece; Aspasia Kanta,University of Patras, Greece; Nikos Piskopos, University of Patras, Greece; Bill Vassiliadis, University of Patras, Greece; Athanassios Tsakalidis, University of Patras, Greece; John Tsaknakis, University of Patras, Greece; Evangelos Sakkopoulos, University of Patras, Greece; Christos Makris, University of Patras, Greece

This work describes how collaborative, extranet-based services can be used to teach virtual classes to geographically-dispersed academic participants. Eurydices is an extranet-based training application, whose aim is the efficient management of the great variety of users and courses provided by the Greek Universities Network (GUNet).

A Web-based educational tool for solving equations

Maria Virvou, University of Piraeus, Greece; Maria Moundridou, University of Piraeus, Greece; Michael Loizos, University of Piraeus, Greece; Athanasios Papachristou, University of Piraeus, Greece; Nikolaos Polyzotis, University of Piraeus, Greece

This paper describes a web-based intelligent authoring tool for constructing problems in the area of equation solving. The main objective of this tool is to be useful to teachers and students of high school level in the area of algebraic equations. The teacher using this tool is able to provide the information needed to construct an exercise through a user-friendly interface on the web. Every exercise that has been constructed is immediately available to students. The tool also monitors students closely while they are solving the exercises through its student modelling component. The aspects we consider important in this tool are:

- The authoring capabilities it embodies. Teachers can continuously add new exercises and be assisted at their construction. Therefore the tool can be very useful for the construction of student assignments and/or exam tests.
- It is a Web-based tool. Therefore it can be used as a support tool for distance learning. It can also be used in classrooms and/or home as homework, exam tests, student practice or tutorial.
- The tool has ITS features such as the diagnostic capability. In this sense the tool can help the teacher to assess his/her students' progress and level of knowledge. It can also be very helpful at marking the assignments and/or exam tests. In addition it can be very useful to students in two ways. First for the self-assessment of their skills and second for the practice they can have with the provision of individualised feedback.

Constructing a Learning Environment for Knowledge Advancement

Feng-Kwei Wang, University of Missouri - Columbia, USA

The purpose of this research is to introduce the use of technology to construct a learning environment for knowledge advancement through three levels of knowledge -- know-what, know-how, and know-why. Know-what is concept-based domain content which is prepackaged and generalized. Know-how translates know-what into action-oriented skills. Know-why permits one to renew know-what and know-how and thus to solve larger and more complex problems. Different levels of knowledge require different learning methods and entail different learning activities. The most efficient approach to acquiring know-what is through comprehension and feedback. The process-based know-how can be best achieved through practices in simulation and case studies. Know-why can only be built over time through personal encounters with many different problems and solutions in real-world projects. This poster session will depict the theoretical grounds of this knowledge advancement framework and show how technology is employed to construct a learning environment based on this framework.

The Use of Cooperative and Collaborative learning in a Web-based Integrated Curriculum for the First Two Years of an Engineering Program of Study

John Watret, Embry-Riddle Aeronautical University, USA; Charles Martin, Embry-Riddle Aeronautical University, USA

The authors will describe and present the results of an innovative Integrated Curriculum in Engineering (ICE) designed for the first two years of an engineering program. Entering freshmen engineering student volunteers are placed into specifically designed sections of the foundation courses required of all engineering students: the calculus sequence, the physics sequence, the humanities sequence, social science, and introductory engineering courses. What differentiates the ICE program from traditional engineering curricula is that all courses incorporate cooperative and collaborative learning and a reliance in computer and web technology. In addition, the ICE program promotes team learning, team design projects, and a well-documented series of assessment practices. Although our program was written for an engineering curriculum, the underlying philosophy is applicable to a wide spectrum of programs of study as well as the general education component of many degrees.

Distance Learning For Government Agencies / Online Academies

Joseph Wilczak, American West Enterprise, USA

Government agencies are turning to online presentation formats for computer based instruction related to distance learning. CBT lends itself well to innovative visual curriculum and realtime information sharing. The educational / training implications that combine computer technology, the internet, email, and telecommunications are enormously untapped. CD Rom, online student / instructor interaction through chat rooms, or both are utilized. Material is presented in text supported with voice overs, and graphics. While writing screen text, voice over scripts should be written simultaneously, and graphics last. Lectures can be conducted online supported by video telecommunications. A final online exam is provided at the completion of each course with follow up sessions scheduled depending on course content. Presentations are suitable for newly enrolled student course material as well as recertification or ongoing certification requirements of the particular agency.

The Management of the Telecommunications Function: The Impact on Organizational Support, Planning and Training Quality

John Willems, Eastern Illinois University, USA; Karen Ketler, Eastern Illinois University, USA

This article reports the results of a survey of marketing managers in order to obtain information from the end user about the impact of the management structure of the telecommunications function on 1) the importance of the function within the organization, 2) the formalization of planning practices and 3) the quality of training on thirty issues. While the information systems manager was the most common form of management of the telecommunication function, the organizations with a distinct telecommunications manager reported greater satisfaction with top management support and a more formalized telecommunications planning and implementation process than the other organizations. The respondents from the organizations with a telecommunications manager also indicated better telecommunications training (although still somewhat unsatisfactory) than the other respondents. This was especially true in the managerial issues with a long term focus such as the use of telecommunications to gain a competitive advantage, and managing innovation and technology.

Online Learning Communities: Vehicles for Collaboration in

Stephanie Woolley, University of Colorado at Denver, United States; Stacey Ludwig-Hardman, University of Colorado at Denver, United States

Learning communities are environments that encourage mutual exchange between community members to support their individual and collective learning. Learning communities are founded on the social negotiation of meaning. Collaboration is the key tenet of constructivism and small-group theory (Springer Springer, Stanne, & Donovan, 1999; Grabinger, 1995; Duffy & Jonassen, 1992) that explains the social component of learning and demonstrates that "conceptual growth comes from sharing perspectives and modifying our internal representations in response to that sharing" (Grabinger, 1995, p. 669). Online learning communities provide the means for achieving "shared creation" and "shared understanding" (Shrage, 1991, p. 40). They are an excellent tool for integrating collaboration in online learning environments. The authors' poster demonstration defines collaboration and learning communities and addresses their theoretical foundations. The authors will discuss the benefits of collaboration and learning communities in online learning environments and provide a case study of a new online learning community at Western Governors University.

The Construction of World-Wide-Web Resource for Chinese Medicine and Acupuncture

Fan Wu, China Medical College, Taiwan; Shao-Fu Huang, China Medical College, Taiwan

As the information technology makes great strides in recent years, Internet has irresistibly reached into every aspect of our daily life. With its unique capability of well-integrating text, image and video, World-Wide-Web has been pervasive in the dissemination of medical discovery, the promotion of medical education and the application of clinical medicine. The issue of capitalizing on the state-of-the-art web technology to build Chinese medicine and acupuncture multi-media web resource is well addressed in this thesis. It is organized around:

1. The largest Chinese medicine news web site domestically.
2. The Chinese-medicine-centric high resolution multi-media Video on Demand in the field of Chinese medicine.
3. The electronic journal on Chinese medicine in the field of Chinese medicine.
4. The virtual classroom with complete features on Chinese Medicine and group-learning systems.

In addition, all the relevant web sites on Chinese medicine will be listed and linked for the benefit of the public. Integrated with Chinese medicine database, this set of medical resource helps to present teachers and researchers with an informative environment surrounded by Chinese medicine data. And it gives students the chance of individual learning and the space for the development for voluntary acquisitiveness for knowledge as well as paves the way for academic exchanges and pervasion of the information on Chinese medicine.

Automatic Generation of the Optimal Tutorial-Plan in Adaptive Educational Hypermedia System

Haiyan Xu, University of Science & Technology of China, P.R.China; XueHai Zhou, University of Science & Technology of China, P.R.China; Zhenxi Zhao, University of Science & Technology of China, P.R.China

Adaptive hypermedia system provides a good framework for web-based education. An ideal adaptive educational hypermedia system adapts to different learners during the whole period of the study. Aiming at the automatic generation of the adaptive tutorial-plan, we simply introduce the architecture of the KDAEHS: an adaptive educational hypermedia system based on structural computing, propose the concept of knowledge structure graph represented by AND/OR graph and then discusses the algorithms used to obtain optimal tutorial plan. Combined with the pedagogical strategies specified by the instructors, KDAEHS generates the optimal tutorial-plan which adapts to different learners based on the knowledge structure graph and the learners' knowledge level. Every tutorial-plan is well suit to the individual learner and can help the learner to fulfill the study goal efficiently.

Virtual Reality in astronomy teaching

Yoav Yair, CET / The Open University, Israel; Rachel Mintz, CET / Tel-Aviv University, Israel; Shai Litvak, CET / Tel-Aviv University, Israel

A new 3D model of the solar system with virtual reality (VR) features. It is based on powerful scientific visualization techniques and can be used as an effective aide in astronomy teaching is presented. The model allows for a powerful learning experience, and facilitates the mental construction of three-dimensional space, where objects are varied and different, but share common features and obey the same physical principles. The learner "enters" a virtual model of the physical world, journeys through it, zooms in or out as he wishes, changes his view point and perspective, as the virtual world continues to "behave" and operate in its usual manner. The new view helps to overcome the inherent geocentric view and ensures the transition to a scientific, heliocentric view of the solar system.

Uncovering cognitive processes in discourse synthesis using hypermedia

Shu Ching Yang, National Sun Yat-Sen University, Taiwan ROC

An exploratory study was undertaken to uncover the cognitive process of discourse synthesis within a hypermedia learning environment. The focus was on learners' discourse synthesis behavior and the problem solving strategies they employed using the Perseus database. The data for the study was transcribed from tape recordings of the 'thinking aloud' protocols as the learners attempted to work on their tasks. All protocols were transcribed verbatim and categorized according to each strategies content. A functional taxonomy were developed to characterize the cognitive operations and thinking processes of the learners' interactions with Perseus. The proposed taxonomy characterizes their cognitive engagement within hypermedia from a broader context. It is a multifaceted construct which entails thick cognition with many highly correlated factors. The study is concluded with practical and theoretical concerns emerging out of this focus on discourse synthesis within hypermedia.

Integrating Technology Into the Curriculum

Rosanne Yost, University of South Dakota, USA; Ray Thompson, University of South Dakota, USA

This session describes a teacher education course designed to help K-12 educators integrate technology into their curriculums. The Technology for Training and Development (TTD) Division at the University of South Dakota has developed the course by using the same curriculum planning process that the course is designed to teach. The overall goal of TTD 782: Technology Integration, is to help teachers develop an understanding of the potential for technology to transform school curriculum so that it is student centered and future orientated. As the professors have modeled the curriculum planning process they teach to their students they have themselves become better at using technology. The benefits to both teacher educators and classroom teachers have included classrooms where active learning occurs and where students gain some control over there own learning. A variety of learning styles and needs are now being met as teachers and students learn "how to learn" together.

Using Web Resources to Enhance the Interdisciplinary Nature of Freshman Preceptorial Course

Kesheng Yu, Union College, USA

The purpose of this poster is to demonstrate the design and development of the web-based set of materials designed to help instructors become familiar with topics or readings in which the preceptors' group has little expertise. The focus of Freshman Preceptorial is on cultural difference and on contemporary issues seen in historical or philosophical perspective. Three Freshman Preceptorial projects were funded in 1998 and 1999. While two of these projects are still in the progress, the Resources for Teaching the Bible are finished. This website is designed for faculty teaching and students taking Freshman Preceptorial, though others are certainly welcome to use it. While the demonstration of the design and development of the web resources, the effect of web resources on Freshman Preceptorial course and student attitude toward the use of the web resources would be discussed as well. The URL for the web site: http://www.union.edu/RESOURCES/curriculum/fpbible/

Development of an Virtual University Online Course Using an Interprofessional Approach to Teach Qualitative Research

Cheryl Zaccagnini, Shippensburg University, US; Denise Anderson, Shippensburg University, US; Kent Chrisman, Shippensburg University, US

Using an interprofessional approach, a qualitative research course was designed and taught as a virtual university course. Professors from the disciplines of early childhood, special education, and social work developed a qualitative research online course to utilize virtual university resources to reach graduate and undergraduate students at distant education sites. It was developed to implement the course as an interactive research course with web-based programming and video conferencing sites to enhance the quality of the course and to provide sufficient web-based content but most importantly to create an atmosphere of communication and connectedness with the professors and students at other sites. Syllabi was developed using a team teaching approach with access to the professors via video conferencing, e-mail, and web-based instruction. Formative and summative evaluation results indicate that teaching qualitative research through virtual university resources can be an effective alternative.

Going the Distance:Offering Design Curriculum in the University of Utah's Distance Learning MFA in Directing/Theatre Education

David Zemmels, University of Utah, USA

In the fall of 1999, the University of Utah's Department of Theatre, in collaboration with Sundance Institute/Sundance Theatre Lab admitted the first cohort to its pilot distance learning MFA in Directing/Theatre Education. The intent of this session is to provide an overview of the pilot program—its underpinnings, its infrastructure—and examine one solution to offering a theatrical design course within the parameters set by the program. Demonstration and examples of assignments and delivery methods will help conference participants envision ways to use distance learning technologies as part of program development at their home sites.

Merging Fine and Performing Art with Digital Technology:An Exploration of the University of Utah's Arts Technology Certificate Program

David Zemmels, University of Utah, USA

Successfully integrating traditional forms of artistic expression with digital technology is an ongoing challenge in the fine and performing arts. In the 21st Century, digital art forms will likely become even more important. Computer technology has become a pervasive and necessary aspect of the arts, whether you are a music therapist, art historian, actor, musician, designer, photographer, or painter. This past fall, the University of Utah's College of Fine Arts began the Arts Technology Certificate Program, an interdisciplinary pilot program offering classes in digital technology as a tool for artistic expression across all art forms. The intent of this session is to provide an overview of the pilot program and the methods and strategies used to implement it, and to showcase representative examples of student work. Demonstration participants will also explore ways to integrate digital technology curriculum as part of program development at their home sites.

Comprehensive Examinations via e-mail

David Zimmerman, James Madison University, USA

This paper will examine the electronic administration of the written comprehensive examination for the Masters Degree in School Library Media Services from James Madison University. Prior to the fall semester, 1998, all students traveled to the main campus in Harrisonburg, Virginia to take the three hour exam. Beginning in November, 1998, four students were sent the exam via e-mail and returned their responses via the same method. The following paper will include a comparison of the two methods of administration, the results of a seven-item questionnaire and a review of the James Madison University Honor System.